Vivekanand Education Society's College of Pharmacy (Autonomous)

Hashu Advani Complex, Near Collector's Colony, Chembur (E) Mumbai 400074

Affiliated to University of Mumbai

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	Bachelor of Pharmacy (B. Pharm.)
2	Eligibility for Admission	HSC/ CET
3	Passing Marks	50%
4	Ordinance/ Regulations if any	
5	No. of Years / Semesters	Four Years / Eight Semester
6	Level	UG
7	Pattern	Semester
8	Status	Revised
9	To be implemented from Academic Year	From Academic year 2024-25

Date: 18/05/2024

Signature:

Name of BOS Chairperson Dr. Supriya Shidhaye

Vivekanand Education Society's College of Pharmacy (Autonomous)

Hashu Advani Complex, Near Collector's Colony, Chembur (E) Mumbai 400074

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Scheme and Syllabus for
CHOICE BASED CREDIT SYSTEM
Bachelor of Pharmacy, B. Pharm.
for
Undergraduate Programme

Revised Course (Revised 2024)

Effective from Academic Year 2024-25

INTRODUCTION

ALIGNING SYLLABUS WITH THE VISION OF NEP 2020

As an autonomous college, we are committed to staying at the forefront of educational reform and ensuring that our curriculum reflects the latest advancements in pedagogy and policy. In light of the National Education Policy (NEP) 2020, we have undertaken a comprehensive review and revision of our syllabus to align it with the guidelines set forth in the NEP.

Our revised syllabus reflects our commitment to excellence, innovation, and skill enhancement in education, in alignment with the goals and principles of the National Education Policy 2020. We believe that by embracing these changes, we can better prepare our students to thrive in a rapidly evolving global landscape and contribute meaningfully to society.

RECOMMENDATIONS OF NATIONAL REGULATORY AUTHORITIES

The University Grants Commission (UGC), the National Assessment and Accreditation Council (NAAC), the Distance Education Council (DEC) and the National Knowledge Commission (NKC) have time and again come out with recommendations for improving the quality and effectiveness of Higher education provisions in the country. The ministry of Human Resource Development at the Central level and the Ministry of Higher & Technical Education, Govt. of Maharashtra have also repeatedly stressed on the need for universities to pay prompt attention to improve the quality of education. The National Knowledge Commission (NKC), in its report to the Prime Minister on 29th November 2006) has also reiterated the importance of higher education and the contribution it has made to economic development, social progress and political democracy in independent India.

An important concern voiced more strongly in recent times, is the need to develop a Choice- Based Credit System (CBCS) in tune with global trends and the adoption of a sound grading system for reflecting learner performance. This is in line with the **recommendation of the UGC** in its Action Plan for Academic and Administrative Reforms (Ref. UGC letters January 2008; March 2009) "……. Curricular flexibility and learners' mobility are issues that warrant our urgent attention. These can be addressed by introducing credit based courses and credit accumulation. In order to provide with some

degree of flexibility to learners, we need to provide flexibility in course selection and also a minimum as well as a maximum permissible span of time in which a course can be completed by a learner… The Choice- Based Credit System (CBCS) imminently fits into the emerging socioeconomic milieu, and could effectively respond to the educational and occupational aspirations of the upcoming generations. In view of this, institutions of higher education in India would do well to invest thought and resources into introducing CBCS. Aided by modern communication and information technology, CBCS has a high probability to be operationalized efficiently and effectively — elevating learners, institutions and higher education system in the country to newer heights…".

RATIONALE FOR INTRODUCTION OF CREDIT AND GRADING SYSTEM

The UGC while outlining the several unique features of the Choice-Based Credit System (CBCS) has, in fact, given in a nutshell, the rationale for its introduction. Among the features highlighted by the UGC are: *Enhanced learning opportunities, ability to match learners' scholastic needs and aspirations, inter-institution transferability of learners (following the completion of a semester), part-completion of an academic programme in the institution of enrolment and part-completion in a specialized (and recognized) institution, improvement in educational quality and excellence, flexibility for working learners to complete the programme over an extended period of time, standardization and comparability of educational programmes across the country, etc.*

This Choice Based Credit System enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning, not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. It can be concluded from the above discussion that it is very much essential to implement the Choice Based Credit System in higher education in India. Course credit structure, examination/assessment and grading are mainly focused aspects of this manual and discussed in subsequent chapters.

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DIRECTIVES OF PHARMACY COUNCIL OF INDIA

The Pharmacy Council of India (PCI) in exercise of the powers conferred to it under the sections 10 and 18 of the Pharmacy Act 1948 (8 of 1948), with the approval of the Central Government, had made the Bachelor of Pharmacy (B. Pharm.) Course Regulations, 2014 and Master of Pharmacy (M. Pharm.) Course regulations vide Gazette dated December 10, 2014. Further as per regulations 6 and 8 of the above course regulations the PCI has also prescribed the Rules and Syllabus for B. Pharm. course and Scheme and Syllabus for M. Pharm., its letter Ref 14-136/2016-PCI and Ref 14-154/2015 PCI dated December 21, 2016, with the subject heading "Statutory Scheme/Rules and syllabus for B. Pharm and M. Pharm. courses". It is thus mandatory to implement the directives of PCI with regard to the Rules/Regulations/Syllabus for recognition and extension of approval of B. Pharm. and M. Pharm. programs of institutes/Universities by the PCI

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1. Short Title and Commencement

These regulations shall be called as "Academic Regulations for the Bachelor of Pharmacy (Revised 2024) Choice Based Credit System (CBCS) of the Vivekanand Education Society's College of Pharmacy, Chembur, Mumbai (Autonomous). They shall come into effect from the Academic Year 2024-25. The regulations framed are subject to modifications from time to time by Board of studies & Academic Council of VESCOP & guidelines by Pharmacy Council of India.

2. Minimum qualification for admission

Admission to the B. Pharm. program of Autonomous College is governed by the rules and regulations of University of Mumbai and is as per norms of the Govt. of Maharashtra through the State CET-CELL (Maharashtra State), the Pharmacy Council of India (PCI, New Delhi). Minimum qualification for admission into Bachelor of Pharmacy program would be according to the rules and regulations of PCI, Government of Maharashtra and University of Mumbai in force at the time of admission.

Admission criteria for First Year B. Pharm is as follows:

The candidate should be an Indian National; Passed HSC or its equivalent examination with Physics and Chemistry as compulsory subjects along with one of the Mathematics or Biology and obtained at least 45% marks (at least 40% marks in case of candidates of Backward class categories, Economically Weaker Section and Persons with Disability belonging only to Maharashtra State) in the above subjects taken together; The candidate should have appeared in all the subjects in MHT-CET and obtain non zero score in MHT-CET. Any other criterion declared from time to time by the appropriate authority as defined under the Act.

All admissions will be done as per Rules and Regulations prescribed from time to time in the information brochure published by State CET Cell, Maharashtra State for the said academic year.

Admission criteria for admission into Semester III of Bachelor of Pharmacy (Lateral Entry to Second Year B. Pharm.) is as follows:

The candidate should be an Indian National; Passed Diploma Course in Pharmacy with at least 45% marks (at least 40% marks in case of candidates of Backward class categories, Economically Weaker Section and Persons with disability belonging to Maharashtra State only) from an Pharmacy Council of India or Central or State Government approved Institution or its equivalent. Any other criterion declared from time to time by the appropriate authority as defined under the Act.

3. Duration of the program

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

4. Medium of instruction and examinations

Medium of instruction and examination shall be in English.

5. Working days in each semester

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

6. Attendance and progress

According to Mumbai University ordinance O.6086 (repealing O.119, O.120 and O.125), it is mandatory for every learner to have minimum 50% attendance for each course and average attendance of all the courses together has to be 75% in each semester. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

7. Program/ Course credit structure

As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, tutorial hours, practical classes, etc. are measured in terms of credits. On satisfactory completion of the courses, a candidate earns credits. The amount of credit associated with a course is dependent upon the number of hours of instruction per week in that course. Similarly, the credit associated with any of the other academic, co/extra-curricular activities is dependent upon the quantum of work expected to be put in for each of these activities per week.

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Credit assignment

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.

Minimum credit requirements

The minimum credit points required for award of a B. Pharm. degree is 210 credits plus Minimum 3 credits and maximum 5 credits of add on course, extracurricular and co-curricular activities. These credits are divided into Theory courses, Tutorials, Practical, Practice School, Project and extra/co-curricular activities over the duration of eight semesters. The credits are distributed semester-wise as shown in Table IX. Courses generally progress in sequences, building competencies and their positioning indicates certain academic maturity on the part of the learners. Learners are expected to follow the semester-wise schedule of courses given in the syllabus.

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

8. Academic work

A regular record of attendance both in Theory and Practical shall be maintained by the teaching staff of respective courses. A faculty advisor/mentor shall be assigned to advise students on the program, its Course Structure and Curriculum, Choice of Courses, based on his competence, progress, pre-requisites and interest.

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.

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Course/Subject codes:

In the syllabus manual of each program of a particular discipline, subject code is assigned for each course as follows:

First two characters are alphabets and indicate the program of a particular discipline (BP indicates B. Pharm.).

Third digit indicates semester number (1 indicates first Semester).

The next two digits indicate chronological order of the course in the list of the subjects of the respective semester (01 indicates first course in the list of all courses of the respective semester).

Alphabets onward sixth indicates nature of the course i.e. T indicates Theory, P indicates Practical and ET indicates Elective Theory, R indicates Remedial, PS indicates Practice School, PW indicates Project Work.

Table-I: Course of study for semester I

Sr. No.	Course Code	Course Name	Hours Per week			Credits
			Theory	Tutorial	Practical	
1.	BP101T	Human Anatomy and Physiology I	3	1	-	4
2.	BP102T	Pharmaceutical Analysis I	3	1	-	4
3.	BP103T	Pharmaceutics I	3	1	-	4
4.	BP104T	Pharmaceutical Inorganic Chemistry	3	1	-	4
5.	BP105T	Communication skills	2	-	-	2
6.	BP106RBT BP106RMT	Remedial Biology/ Remedial Mathematics	2	-	-	2
7.	BP107P	Human Anatomy and Physiology	-	-	4	2
8.	BP108P	Pharmaceutical Analysis I	-	-	4	2
9.	BP109P	Pharmaceutics I	-	-	4	2
10.	BP110P	Pharmaceutical Inorganic Chemistry	-	-	4	2
11.	BP111P	Communication skills	-	-	2	1
12.	BP112RBP	Remedial Biology	-	-	2	1
Total			**14/16[# or $]**	**4**	**18/20[#]**	**27/29[$]/30[#]**

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

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

Table-II: Course of study for semester II

Sr. No.	Course Code	Course Name	Hours Per week			Credits
			Theory	Tutorial	Practical	
1.	BP201T	Human Anatomy and Physiology II	3	1	-	4
2.	BP202T	Pharmaceutical Organic Chemistry I	3	1	-	4
3.	BP203T	Biochemistry	3	1	-	4
4.	BP204T	Pathophysiology	3	1	-	4
5.	BP205T	Computer Applications in Pharmacy	3	-	-	3
6.	BP206T	Environmental sciences	3	-	-	3
7.	BP207P	Human Anatomy and Physiology II	-	-	4	2
8.	BP208P	Pharmaceutical Organic Chemistry I	-	-	4	2
9.	BP209P	Biochemistry	-	-	4	2
10.	BP210P	Computer Applications in Pharmacy	-	-	2	1
Total			**18**	**4**	**14**	**29**

Table-III: Course of study for semester III

Sr. No.	Course Code	Course Name	Hours Per week			Credits
			Theory	Tutorial	Practical	
1.	BP301T	Pharmaceutical Organic Chemistry II	3	1	-	4
2.	BP302T	Physical Pharmaceutics I	3	1	-	4
3.	BP303T	Pharmaceutical Microbiology	3	1	-	4
4.	BP304T	Pharmaceutical Engineering	3	1	-	4
5.	BP305P	Pharmaceutical Organic Chemistry II	-	-	4	2
6.	BP306P	Physical Pharmaceutics I	-	-	4	
7.	BP307P	Pharmaceutical Microbiology	-	-	4	2
8.	BP308P	Pharmaceutical Engineering	-	-	4	2
9.	IKS_BP_301	Yoga, a key to healthy life (IKS)	2	-	-	-
Total			**14**	**4**	**16**	**24**

IKS: Indian Knowledge System

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Table-IV: Course of study for semester IV

Sr. No.	Course Code	Course Name	Hours Per week			Credits
			Theory	Tutorial	Practical	
1.	BP401T	Pharmaceutical Organic Chemistry III	3	1	-	4
2.	BP402T	Medicinal Chemistry I	3	1	-	4
3.	BP403T	Physical Pharmaceutics II	3	1	-	4
4.	BP404T	Pharmacology I	3	1	-	4
5.	BP405T	Pharmacognosy and Phytochemistry I	3	1	-	4
6.	BP406P	Medicinal Chemistry I	-	-	4	2
7.	BP407P	Physical Pharmaceutics II	-	-	4	2
8.	BP408P	Pharmacology I	-	-	4	2
9.	BP409P	Pharmacognosy and Phytochemistry I	-	-	4	2
10.	VEC_BP_401	Universal Human Values (VEC)	2	-	-	-
Total			**17**	**5**	**16**	**28**

VEC: Value Education Course

Table-V: Course of study for semester V

Sr. No.	Course Code	Course Name	Hours Per week			Credits
			Theory	Tutorial	Practical	
1.	BP501T	Medicinal Chemistry II	3	1	-	4
2.	BP502T	Industrial Pharmacy I	3	1	-	4
3.	BP503T	Pharmacology II	3	1	-	4
4.	BP504T	Pharmacognosy and Phytochemistry II	3	1	-	4
5.	BP505T	Pharmaceutical Jurisprudence	3	1	-	4
6.	BP506P	Industrial Pharmacy I	-	-	4	2
7.	BP507P	Pharmacology II	-	-	4	2
8.	BP508P	Pharmacognosy and Photochemistry II	-	-	4	2
9.	SEC_BP_501	Spectroscopy and Chromatography Basics: A Hands-On Approach (SEC)	2	-	-	-
Total			**17**	**5**	**12**	**26**

SEC: Skill Enhancement Course

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Table-VI: Course of study for semester VI

Sr. No.	Course Code	Course Name	Hours Per week			Credits
			Theory	Tutorial	Practical	
1.	BP601T	Medicinal Chemistry III	3	1	-	4
2.	BP602T	Pharmacology III	3	1	-	4
3.	BP603T	Herbal Drug Technology	3	1	-	4
4.	BP604T	Biopharmaceutics and Pharmacokinetics	3	1	-	4
5.	BP605T	Pharmaceutical Biotechnology	3	1	-	4
6.	BP606T	Quality Assurance	3	1	-	4
7.	BP607P	Medicinal chemistry III – Practical	-	-	4	2
8.	BP608P	Pharmacology III – Practical	-	-	4	2
9.	BP609P	Herbal Drug Technology – Practical	-	-	4	2
Total			**18**	**6**	**12**	**30**

Table-VII: Course of study for semester VII

Sr. No.	Course Code	Course Name	Hours Per week			Credits
			Theory	Tutorial	Practical	
1.	BP701T	Instrumental Methods of Analysis	3	1	-	4
2.	BP702T	Industrial Pharmacy II	3	1	-	4
3.	BP703T	Pharmacy Practice	3	1	-	4
4.	BP704T	Novel Drug Delivery System	3	1	-	4
5.	BP705P	Instrumental Methods of Analysis	-	-	4	2
6.	BP706PS	Practice School	-	-	12	6
7.	AEC_BP_701	Scientific writing (AEC)	2	-	-	-
Total			**14**	**4**	**16**	**24**

AEC: Ability Enhancement Course

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Table-VIII: Course of study for semester VIII

Sr. No.	Course Code	Course Name	Hours Per week			Credits
			Theory	Tutorial	Practical	
1.	BP801T	Biostatistics and Research Methodology	3	1	-	4
2.	BP802T	Social and Preventive Pharmacy	3	1	-	4
3.	BP803ET	Pharma Marketing Management	3 + 3 = 6	1 + 1 = 2	-	4 + 4 = 8
4.	BP804ET	Pharmaceutical Regulatory Science				
5.	BP805ET	Pharmacovigilance				
6.	BP806ET	Quality Control and Standardization of Herbals				
7.	BP807ET	Computer Aided Drug Design				
8.	BP808ET	Cell and Molecular Biology				
9.	BP809ET	Cosmetic Science				
10.	BP810ET	Experimental Pharmacology				
11.	BP811ET	Advanced Instrumentation Techniques				
12.	BP812ET	Dietary Supplements and Nutraceuticals				
13.	BP813PW	Project Work	-	-	12	6
14.	SEC_BP_801_E	Entrepreneurship Management (VSC)	2	-	-	-
	VSC_BP_801_E	Experimental Techniques in Biotechnology (SEC)				
Total			**14**	**4**	**12**	**22**

VSC: Vocational Skill enhancement Course

SEC: Skill Enhancement Course

Table-IX: Semester wise credits distribution

Semester	Credit Points
I	27/29$^{\$}$/30$^{\#}$
II	29
III	24
IV	28
V	26
VI	30
VII	24
VIII	22
Extracurricular/ Co-curricular activities	Minimum 03 & Maximum 05*
Total credit points for the program	**210/212$^{\$}$/213$^{\#}$ Plus** Minimum 03 & Maximum 05 credits of Extracurricular/ Co-curricular activities

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* The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principal of the autonomous college. The criteria to acquire this credit point shall be defined by the colleges Academic Council from time to time.

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

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

Extracurricular/ Co-curricular activities - 5 CreditsRules and Regulations:

Category	Rules	Minimum No. of contact hours	Credits
Add on courses	• (1 credit Compulsory) (In campus/Off campus) (Offline/online)One credit - Each short-term course certificate as per UGC norms for add on courses. (30hrs Duration/8 weeks). • Others discretion of COE/Principal.	15	1 Credit compulsory
Extracurricular	• Participation in any of the extracurricular activities.	15	1 Credit compulsory
Social Work	• PHO/ Rotaract. Students have to participate at least once in four years in any of the above listed activities.	15	1 Credit compulsory
Co-curricular	• One publication – 2 credits • Two Presentations at state/ National level seminars/conferences- 1 credit per presentation (Maximum 2 credits) • Others discretion of R&D Director/COE/Principal.	15	2 Credits Optional

Credits of Extracurricular/ Co-curricular activities will be added in Semester VIII marksheet.

10. Program Committee

1. The B. Pharm. program shall have a Program Committee constituted by the Principal of Autonomous College in consultation with all the Heads of the departments.
2. The composition of the Program Committee shall be as follows:

   A senior teacher shall be the Chairperson; One Teacher from each department handling B.Pharm courses; and four student representatives of the program (one from each academic year), nominated by the Head of the institution.

3. Duties of the Program Committee:

   i. Periodically reviewing the progress of the classes.

   ii. Discussing the problems concerning curriculum, syllabus and the conduct of classes.

   iii. Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.

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

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

11. Examinations/Assessments

Semester wise performance assessment of every registered learner is to be carried out through various modes of examinations, in both theory and laboratory classes. These include Internal Assessment and End Semester Examination.

A time-table and question papers for all the theory examinations of different semesters will be prepared/set by the Controller of examination (COE) of autonomous college as per the procedure. The assessment and moderation of the answer booklets for the examinations in Theory courses in Semesters I to VIII will be carried out by autonomous college.

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

11.1End semester examinations

The End Semester Examinations in Semesters I, II, III, IV, V, VI, VII and VIII of the B. Pharm. Degree course will be conducted by autonomous colleges where the learner has been admitted following rules and regulations.

The End Semester Examinations for each theory and practical course through semesters I to VIII shall be conducted by Board of examination and evaluation of autonomous college. On submission of gazette with report of lower examination, degree certificate will be issued by University of Mumbai.

A time-table and question papers for all the theory examinations of different semesters will be prepared/set by the Autonomous college as per the procedure. The question papers for the Theory courses in Semesters I, II, III, IV, V, VI, VII, and VIII will be set by examiners and paper-setters appointed by the Controller of examination of autonomous college.

The assessment and moderation of the answer booklets for the examinations in Theory courses in Semesters I to VIII will be carried out by Autonomous colleges by the examiners and moderators appointed by the COE of Autonomous colleges for each paper from the panel approved by the Board of Studies UG of autonomous college.

COE of the autonomous colleges is authorized to appoint examiners in the Practical examinations at Semesters I to VIII from the panel of suitable persons for appointment as examiners prepared by the Board of Studies UG of autonomous college.

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

Semester I

Sr. No.	Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
			Continuous Mode	Sessional Exams		Total	Marks	Duration	
				Marks	Duration				
1.	BP101T	Human Anatomy and Physiology I– Theory	10	15	1 Hr	25	75	3 Hrs	100
2.	BP102T	Pharmaceutical Analysis I – Theory	10	15	1 Hr	25	75	3 Hrs	100
3.	BP103T	Pharmaceutics I – Theory	10	15	1 Hr	25	75	3 Hrs	100
4.	BP104T	Pharmaceutical Inorganic Chemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100
5.	BP105T	Communication skills – Theory	5	10	1 Hr	15	35	1.5 Hrs	50
6.	BP106RBT BP106RMT	Remedial Biology/ Mathematics – Theory	5	10	1 Hr	15	35	1.5 Hrs	50
7.	BP107P	Human Anatomy and Physiology– Practical	5	10	4 Hrs	15	35	4 Hrs	50
8.	BP108P	Pharmaceutical Analysis I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
9.	BP109P	Pharmaceutics I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
10.	BP110P	Pharmaceutical Inorganic Chemistry – Practical	5	10	4 Hrs	15	35	4 Hrs	50
11.	BP111P	Communication skills – Practical	5	5	2 Hrs	10	15	2 Hrs	25
12.	BP112RBP	Remedial Biology – Practical	5	5	2 Hrs	10	15	2 Hrs	25
	Total		**70/75$/80#**	**115/125$/130#**	**23/24$/26# Hrs**	**185/200$/210#**	**490/525$/ 540#**	**31.5/33$/ 35# Hrs**	**675/725$/ 750#**

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

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

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Semester II

Sr. No.	Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
			Continuous Mode	Sessional Exams		Total	Marks	Duration	
				Marks	Duration				
1.	BP201T	Human Anatomy and Physiology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
2.	BP202T	Pharmaceutical Organic Chemistry I – Theory	10	15	1 Hr	25	75	3 Hrs	100
3.	BP203T	Biochemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100
4.	BP204T	Pathophysiology – Theory	10	15	1 Hr	25	75	3 Hrs	100
5.	BP205T	Computer Applications in Pharmacy – Theory	10	15	1 Hr	25	50	2 Hrs	75
6.	BP206T	Environmental sciences – Theory	10	15	1 Hr	25	50	2 Hrs	75
7.	BP207P	Human Anatomy and Physiology II –Practical	5	10	4 Hrs	15	35	4 Hrs	50
8.	BP208P	Pharmaceutical Organic Chemistry I– Practical	5	10	4 Hrs	15	35	4 Hrs	50
9.	BP209P	Biochemistry – Practical	5	10	4 Hrs	15	35	4 Hrs	50
10.	BP210P	Computer Applications in Pharmacy – Practical	5	5	2 Hrs	10	15	2 Hrs	25
	Total		**80**	**125**	**20 Hrs**	**205**	**520**	**30 Hrs**	**725**

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Semester III

Sr. No.	Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
			Continuous Mode	Sessional Exams		Total	Marks	Duration	
				Marks	Duration				
1.	BP301T	Pharmaceutical Organic Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
2.	BP302T	Physical Pharmaceutics I –Theory	10	15	1 Hr	25	75	3 Hrs	100
3.	BP303T	Pharmaceutical Microbiology – Theory	10	15	1 Hr	25	75	3 Hrs	100
4.	BP304T	Pharmaceutical Engineering – Theory	10	15	1 Hr	25	75	3 Hrs	100
5.	BP305P	Pharmaceutical Organic Chemistry II – Practical	5	10	4 Hr	15	35	4 Hrs	50
6.	BP306P	Physical Pharmaceutics I – Practical	5	10	4 Hr	15	35	4 Hrs	50
7.	BP307P	Pharmaceutical Microbiology – Practical	5	10	4 Hr	15	35	4 Hrs	50
8.	BP308P	Pharmaceutical Engineering – Practical	5	10	4 Hr	15	35	4 Hrs	50
9.	IKS_BP_301	Yoga, a key to healthy life (IKS)	-	-	-	-	-	-	-
	Total		**60**	**100**	**20**	**160**	**440**	**28 Hrs**	**600**

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Semester IV

Sr. No.	Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
			Continuous Mode	Sessional Exams		Total	Marks	Duration	
				Marks	Duration				
1.	BP401T	Pharmaceutical Organic Chemistry III– Theory	10	15	1 Hr	25	75	3 Hrs	100
2.	BP402T	Medicinal Chemistry I – Theory	10	15	1 Hr	25	75	3 Hrs	100
3.	BP403T	Physical Pharmaceutics II – Theory	10	15	1 Hr	25	75	3 Hrs	100
4.	BP404T	Pharmacology I – Theory	10	15	1 Hr	25	75	3 Hrs	100
5.	BP405T	Pharmacognosy I – Theory	10	15	1 Hr	25	75	3 Hrs	100
6.	BP406P	Medicinal Chemistry I – Practical	5	10	4 Hr	15	35	4 Hrs	50
7.	BP407P	Physical Pharmaceutics II – Practical	5	10	4 Hrs	15	35	4 Hrs	50
8.	BP408P	Pharmacology I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
9.	BP409P	Pharmacognosy I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
10.	AUDIT COURSE	Universal Human Values (VEC)	-	-	-	-	-	-	-
	Total		**70**	**115**	**21 Hrs**	**185**	**515**	**31 Hrs**	**700**

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Semester V

Sr. No.	Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
			Continuous Mode	Sessional Exams		Total	Marks	Duration	
				Marks	Duration				
1.	BP501T	Medicinal Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
2.	BP502T	Industrial Pharmacy I– Theory	10	15	1 Hr	25	75	3 Hrs	100
3.	BP503T	Pharmacology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
4.	BP504T	Pharmacognosy II – Theory	10	15	1 Hr	25	75	3 Hrs	100
5.	BP505T	Pharmaceutical Jurisprudence – Theory	10	15	1 Hr	25	75	3 Hrs	100
6.	BP506P	Industrial Pharmacy I– Practical	5	10	4 Hr	15	35	4 Hrs	50
7.	BP507P	Pharmacology II – Practical	5	10	4 Hr	15	35	4 Hrs	50
8.	BP508P	Pharmacognosy II – Practical	5	10	4 Hr	15	35	4 Hrs	50
9.	SEC_BP_501	Spectroscopy and Chromatography Basics: A Hands-On Approach (SES)	-	-	-	-	-	-	-
	Total		**65**	**105**	**17 Hr**	**170**	**480**	**27 Hrs**	**650**

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Semester VI

Sr. No.	Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
			Continuous Mode	Sessional Exams		Total	Marks	Duration	
				Marks	Duration				
1.	BP601T	Medicinal Chemistry III – Theory	10	15	1 Hr	25	75	3 Hrs	100
2.	BP602T	Pharmacology III – Theory	10	15	1 Hr	25	75	3 Hrs	100
3.	BP603T	Herbal Drug Technology – Theory	10	15	1 Hr	25	75	3 Hrs	100
4.	BP604T	Biopharmaceutics and Pharmacokinetics – Theory	10	15	1 Hr	25	75	3 Hrs	100
5.	BP605T	Pharmaceutical Biotechnology– Theory	10	15	1 Hr	25	75	3 Hrs	100
6.	BP606T	Quality Assurance– Theory	10	15	1 Hr	25	75	3 Hrs	100
7.	BP607P	Medicinal chemistry III – Practical	5	10	4 Hrs	15	35	4 Hrs	50
8.	BP608P	Pharmacology III – Practical	5	10	4 Hrs	15	35	4 Hrs	50
9.	BP609P	Herbal Drug Technology – Practical	5	10	4 Hrs	15	35	4 Hrs	50
	Total		**75**	**120**	**18 Hrs**	**195**	**555**	**30 Hrs**	**750**

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Semester VII

Sr. No.	Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
			Continuous Mode	Sessional Exams		Total	Marks	Duration	
				Marks	Duration				
1.	BP701T	Instrumental Methods of Analysis – Theory	10	15	1 Hr	25	75	3 Hrs	100
2.	BP702T	Industrial Pharmacy – Theory	10	15	1 Hr	25	75	3 Hrs	100
3.	BP703T	Pharmacy Practice – Theory	10	15	1 Hr	25	75	3 Hrs	100
4.	BP704T	Novel Drug Delivery System – Theory	10	15	1 Hr	25	75	3 Hrs	100
5.	BP705 P	Instrumental Methods of Analysis – Practical	5	10	4 Hrs	15	35	4 Hrs	50
6.	BP706 PS	Practice School	25	-	-	25	125	5 Hrs	150
7.	AEC_BP_701	Scientific writing (AEC)	-	-	-	-	-	-	-
	Total		**70**	**70**	**8 Hrs**	**140**	**460**	**21 Hrs**	**600**

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Semester VIII

Sr. No.	Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
			Continuous Mode	Sessional Exams		Total	Marks	Duration	
				Marks	Duration				
1.	BP801T	Biostatistics and Research Methodology– Theory	10	15	1 Hr	25	75	3 Hrs	100
2.	BP802T	Social and Preventive Pharmacy – Theory	10	15	1 Hr	25	75	3 Hrs	100
3.	BP803ET	Pharmaceutical Marketing – Theory	10 + 10 = 20	15 + 15 = 30	1 + 1 = 2 Hrs	25 + 25 = 50	75 + 75 = 150	3 + 3 = 6 Hrs	100 + 100 = 200
4.	BP804ET	Pharmaceutical Regulatory Science – Theory							
5.	BP805ET	Pharmacovigilance – Theory							
6.	BP806ET	Quality Control and Standardization of Herbals – Theory							
7.	BP807ET	Computer Aided Drug Design – Theory							
8.	BP808ET	Cell and Molecular Biology – Theory							
9.	BP809ET	Cosmetic Science – Theory							
10.	BP810ET	Experimental Pharmacology – Theory							
11.	BP811ET	Advanced Instrumentation Techniques – Theory							
12.	BP812PW	Project Work	-	-	-	-	150	4 Hrs	150
13.	SEC_BP_801_E	Entrepreneurship Management (VSEC) OR	-	-	-	-	-	-	-
14.	VSC_BP_801_E	Experimental Techniques in Biotechnology (SEC)							
	Total		**40**	**60**	**4 Hrs**	**100**	**450**	**16 Hrs**	**550**

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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**	
	100 Marks course	50 Marks Course
Attendance (Refer Table – XII)	4	2
Academic activities	4	2
Student – Teacher interaction	2	1
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
90 – 100	4	2
85 – 89	3	1.5
80 – 84	2	1
75 – 79	1	0.5
Less than 75	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. The scheme of question paper for theory and practical Sessional examinations is given below. Final sessional marks shall be arrived at by considering the marks secured by the student in both the mid examinations with 80% weightage to the better mid examination and 20% to the other. If a learner is absent for any or both of the sessional examinations, the mark for that particular examination shall be considered as zero while calculating the final sessional marks. The re sessional examination shall not be conducted if any student misses the examination. The final

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sessional examinations 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 1 or 2 marks	=	05 x 2 = 10
		OR 10 x 1=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

One of the sub questions should be case study or application based,

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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

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12. Promotion and award of grades

A student shall be declared PASS and eligible for getting grade in a course of B. Pharm. program if he/she secures at least 50% marks in that particular course including internal assessment. For example, to be declared as PASS and to get grade, the student has to secure a minimum of 50 marks for the total of 100 including continuous mode of assessment and end semester theory examination and has to secure a minimum of 25 marks for the total 50 including internal assessment and end semester practical examination.

13. Carry forward of marks

In case a student fails to secure the minimum 50% in any Theory or Practical course as specified 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 immediate next end semester theory examinations.

15. Re-examination of end semester examinations

Reexamination of end semester examination shall be conducted as per the schedule given by the autonomous college. The exact dates of examinations shall be notified from time to time by COE of autonomous college.

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Question paper pattern for end semester theory examinations For 75 marks paper

I. Multiple Choice Questions(MCQs)	=	20 x 1 = 20
OR		OR
Objective Type Questions (10 x 2)	=	10 x 2 = 20
(Answer all the questions 1 or 2 marks)		
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

Three of the sub questions should be case study or application based,

For 50 marks paper

I. Long Answers (Answer 2 out of 3)	=	2 x 10 = 20
II. Short Answers (Answer 6 out of 8)	=	6 x 5 = 30
Total	=	50 marks

For 35 marks paper

I. Long Answers (Answer 1 out of 2)	=	1 x 10 =10
II. Short Answers (Answer 5 out of 7)	=	5 x 5 = 25
Total	=	35 marks

Question paper pattern for end semester practical examinations

I. Synopsis	=	5
II. Experiments	=	25
III. Viva voce	=	5
	Total =	35 marks

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16. Academic Progression:

No student shall be admitted to any examination unless he/she fulfills the norms given in 6. Academic progression rules are applicable as follows:

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

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

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

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

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

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

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

Any student who 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.

16. Grading of performances

Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the end of the semester for each course. The letter grades and their corresponding grade points are given in Table – XII.

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

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

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

17. 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:

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

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

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

18. Cumulative Grade Point Average (CGPA)

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

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

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

19. Declaration of class

Although the GPA system is a stand-alone system of grading not amenable to facile conversion to percent marks, in general the conversion of CGPA to percent marks is: CGPA x 9.5 = Percent marks.

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

First Class with Distinction = CGPA of. 7.37 and above

First Class = CGPA of 6.32 to 7.36

Second Class = CGPA of 6.0

20. 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 COE of autonomous college shall evaluate the project at the time of the Practical examinations of other semester(s). Students shall be evaluated in groups for four hours (i.e., about half an hour for a group of five students). The projects shall be evaluated as per the criteria given below.

Evaluation of Dissertation Book:

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

Evaluation of Presentation:

Presentation of work	25 Marks
Communication skills	20 Marks
Question and answer skills	30 Marks
Total	**75 Marks**

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

21. Industrial training (Desirable)

Every candidate shall be required to work for at least four weeks after SEM IV and Eight Weeks after SEM VI and before the commencement of next semester, and shall submit satisfactory report

of such work and certificate duly signed by the authority of training organization to the head of the institute 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.

22. Practice School

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

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

23. Award of Ranks

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

24. Award of degree

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

25. Duration for completion of the program of study

The duration for the completion of the program shall be fixed as per the norms of the University of Mumbai.

26. Re-admission after break of study

Candidate who seeks re-admission to the program after break of study has to get the approval from the Principal of Autonomous College.

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

27. Audit Courses

Audit courses are mandatory noncredit courses covering the subjects of developing desired attitude, imparting skills or giving value education to learner.

A faculty advisor/mentor shall be assigned to each Audit course to advise students on the program, A candidate is required to submit report at the end of the semester to the examining authority of the Autonomous college. Student must score minimum 50% marks as per the scheme given in Table XIII and Satisfactory report from the concerned faculty is required to declare him/her as pass with specific grade which will get reflected in particular semester grade card.

Table XIII: Scheme for awarding the Grade for Audit Course

Criteria	**Maximum Marks**
Attendance	40%
Academic activities : Case studies, presentation, Assignments	20%
Student – Teacher interaction	10%
Report	30%
Total	**100%**

Award of Grade as per the marks	
Percent Marks obtained	**Grade**
100	O
90	A
80	B
70	C
60	D
50	E
Less Than 50	Fail

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SYLLABUS

Semester I

Course Code	Course Name	Credits
BP101T	**Human Anatomy & Physiology I - Theory**	**4**

- **Prerequisites:**
  - Students should possess the basic knowledge of biology related to cells and systems of the human body.

- **Course Outcomes: After completion of this course students should be able to:**
  1. Outline and categorize the various body structural levels (cells, tissues, organs, and systems) and recall the structure, composition and functions of plasma membrane and methods of movement of substances across plasma membrane.
  2. Explain the anatomy and physiology of skeletal, cardiac and smooth muscle, explain the transmission at the neuromuscular junction and energy metabolism in the muscle as well as the mechanism of skeletal muscle contraction and demonstrate various types of skeletal muscle contraction.
  3. Explain the anatomy and physiology of the Cardiovascular system, Lymphatic system, Endocrine System and examine each system and understand how different organs within them work together in a coordinated manner to achieve their functions.
  4. Explore the current treatments and ongoing research involving stem cells and analyze clinical outcomes associated with organ transplantation.

Sr. No.	Content	Hours
Unit 1:	**Introduction to the human body**	**10**
1.1	**Introduction to the human body** (Definition and scope of anatomy and physiology, levels of structural organization and body systems, Basic physiological concepts such as Evolution, Homeostasis, Flow down gradients, mass balance, scientific reasoning & Introduction to anatomical terminologies) Case studies and clinical applications.	**03**
1.2	**Cellular level of organization** Structure and functions of the cell, transport across cell membrane, cell cycle, 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 Case studies and clinical applications.	**03**
1.3	**Tissue level of organization** Classification of tissues, structure, location, and functions of epithelial, muscular, nervous, and connective tissues. Histology Techniques Case studies and clinical applications.	**04**
2	**Unit 2**	**10**

2.1	**Integumentary system -** Structure and functions of skin **(Self-study)**	
2.1	**Introduction to skin grafting**	**1**
2.2	**Skeletal System** Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction. Case studies and clinical applications	**3**
2.2	**Skeletal System** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system **(Self-study)**	
2.2	**Organ Transplantations and Introduction to regenerative Medicine** A brief history of transplantation, Clinical results in organ transplantation and Introduction to regenerative Medicine	**2**
2.3	**Joints** Structural and functional classification, types of joint movements and their articulation Case studies and clinical applications.	**4**
3	**Unit 3: Body fluids and blood**	**10**
3.1	**Body fluids and blood** Body fluids, composition, and functions of blood, hemopoiesis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance, and disorders of the blood, Reticuloendothelial system. Case studies and clinical applications.	**7**
3.2	**Lymphatic system** Lymphatic organs and tissues, lymphatic vessels, formation & Circulation of lymph and functions of the lymphatic system. Case studies and clinical applications.	**3**
4	**Unit 4: Endocrine system**	**08**
4.1	**Endocrine system** Classification of hormones, mechanism of hormone action, Integration of endocrine and nervous system functions structure and functions of Hypothalamus, pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders. Clinical case studies	**08**
Unit 5:	**Cardiovascular system**	**07**
5.1	**Cardiovascular system** Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of the conduction system of heart and heartbeat, its regulation by the autonomic nervous system, cardiac output, cardiac cycle. Baroreceptors, Chemoreceptors, vasomotor center, humoral and neuronal Regulation of blood pressure, pulse, electrocardiogram.	**05**

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	(Disorders of CVS Self study)	
5.2	**Stem cell** Type of stem cells, treatment, research. and clinical applications.	**02**
	Total Hours	**45**

Recommended Books:

1. Tortora, G.J. and Grabowski, S.R., 2005. Principles of Anatomy and Physiology. HarperCollins College Publishers, New York
2. Guyton, A.C., Textbook of Medical Physiology. W. B. Saunders Co., Philadelphia, USA.
3. Waugh, Anne, Grant, Allison. (2006). Ross and Wilson anatomy and physiology in health and illness (10th , 11th ,12th). Toronto: Churchill Livingstone/Elsevier.
4. Godkar P.B and Godkar D.P., Textbook of Medical Laboratory Technology. Bhalani Publishing House, MumbaiGoyal, R.K., Patel, N.M. and Shah, S.A., Practical Anatomy, Physiology and Biochemistry. B. S. Shah Prakashan, Ahmedabad.
5. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
6. Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.
7. Hematopoietic Stem Cell Transplantation: A Manual For Nursing Practice, Second Edition https://www.ons.org/sites/default/files/publication_pdfs/Sample%20Chapter%200609%20HSCT2nd.pdf

Recommended Articles:

1. Khaddour K, Hana CK, Mewawalla P. Hematopoietic Stem Cell Transplantation. [Updated 2023 May 6]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK536951/
2. Lennard AL, Jackson GH. Stem cell transplantation. West J Med. 2001;175(1):42-46. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1071465/#:~:text=Stem%20cell%20transplantation%20is%20associated,graft%2Dversus%2Dhost%20disease.
3. Michael J, Modell H. Validating the core concept of "mass balance". Advances in Physiology Education. 2021 Jun 1;45(2):276-80.

Recommended Weblinks:

1. https://www.cancer.gov/about-cancer/treatment/types/stem-cell-transplant
2. https://training.seer.cancer.gov/anatomy/body/terminology.html

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Course code	Course Name	Credits
BP102T	**Pharmaceutical Analysis I – Theory**	**4**

- **Prerequisites**
  - Basic knowledge of general chemistry and electrochemistry
  - Mathematical skills for data analysis and interpretation

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Recall with examples the terminologies involved in all types of titrations, gravimetry, electroanalytical methods and errors
  2. Summarize and describe the principle involved and applications of all types of titrations, gravimetry, electroanalytical methods and errors and understand the significance of Pharmaceutical Analysis in quality control and quality assurance of pharmaceuticals
  3. Perform calculations for preparing solutions having different solute concentrations as expressed in various concentration units like Normality, Molarity, ppm, ppb etc. and for inter-conversion of concentration units.

Sr. No.	Content	Hours
1	**UNIT 1**	**11**
1.1	**Pharmaceutical Analysis: Definition and Scope** • Different techniques of analysis: • Methods of expressing concentration: • Primary and secondary standards. • Preparation and standardization of various molar and normal solutions-Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate	**06**
1.2	**Errors:** • Sources of errors, types of errors, methods of minimizing errors, accuracy, precision • Concept and numericals of: Mean, Median, Standard deviation, relative standard deviation • Significant figures- importance, numericals on significant figures	**03**
1.3	• Pharmacopoeia: Different pharmacopoeias, contents of pharmacopoeias (IP Latest Edition), Monograph contents (IP Latest Edition) • Sources of impurities in medicinal agents: Definition, enlist sources • Limit tests- Examples: Chloride, Sulphide, Iron, Arsenic	**02**
2	**UNIT 2**	**08**
2.1	• Titrimetric analysis- Concept, Factor calculation, Reaction requirements for titration • Volumetric apparatus used in titrimetric analysis and least count	**05**

	• Types of titrations based on reaction involved/analyte properties- acid base, redox, precipitation, complexometric, miscellaneous/nitrite. • Types of titrations based on manner in which reaction proceeds: Direct titrations, Back titrations, Back titrations with blank determination • **Acid base titration:** Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curve • Concept of pH, pK_a, pK_b, pK_h, pK_w and their relationships. • Neutralization indicator- colour change theory and interval • Examples: Acid-base titrations of Ammonium chloride, Boric acid, Aminophylline, Nicotinic acid, Chalk, Aspirin	
2.2	**Non aqueous titration:** • Solvents, acidimetry and alkalimetry titration • Limitation of water as solvent in titration of certain analytes. • Types- dissociating, non-dissociating, protogenic, protophillic, amphiprotic and aprotic solvents. • Levelling and differentiating solvents. • Estimation of Sodium benzoate and Ephedrine HCl	**03**
3	**UNIT 3**	**10**
3.1	**Precipitation titrations:** • Solubility product and common ion effect. • Examples of precipitation reaction and their adaptability to titrations. • Fractional precipitation and solubility product. Mohr 's method, Volhard 's, Modified • Titration of neutral halides (NaCl) Mohr's method and Fajan's method. • Titration of Acidic halides (NH_4Cl) Volhard's method.	**02**
3.2	**Complexometric titration**, • Metals, co-ordination number • Ligands and types • Chelating agent, sequestering agent • Metal ion indicators • Complex formation reaction • Factors affecting stability of complexes. Order of stability of certain metal complexes • Masking and demasking agent. • Classification - Direct, back, replacement. • pH curve and metallochromic indicator. Preparation and standardization of 0.05M EDTA	**04**

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	• Estimation of Magnesium sulphate and calcium gluconate.	
3.3	**Gravimetry:** • Principle: Mass as measurement signal and precipitation equilibria • Steps involved in gravimetric analysis: • Organic and inorganic precipitants, • Precipitation from homogeneous solution. • Purity of the precipitate: co-precipitation and post precipitation, Von Weimarn ratio • Estimation of barium sulphate • Numericals related to gravimetric factor	**03**
3.4	• Basic Principles, methods, and application of diazotisation titration: • Analytes, preparation, and standardization of $NaNO_2$ solution, external indicator, reactions, factor calculation for assay of sulphacetamide.	**01**
4	**UNIT 4**	**08**
4.1	**Redox titrations:** • Concepts of oxidation and reduction • Oxidation reduction reaction and balancing E_0 values and oxidizing/reducing agents. • Choice of redox pair on basis of E_0. • End point detection in redox reactions. • Types of indicators: Redox, self, internal, external	**02**
4.2	Types of redox titrations (Principles and applications) Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate: • Theory, indicators, and titrants for: Permanganometry and Cerimetry, Applications- Assay of hydrogen peroxide solution (Permanganometry), Assay of Ascorbic acid tablets, Dried Ferrous sulphate, Paracetamol (Cerimetry). • Theory, indicators, and titrants for: Iodometry, iodimetry, potassium dichromate, potassium iodate and potassium bromate titrations. Applications- Assay of Hydrogen peroxide (permanganometry), Assay of Ascorbic acid API (Iodimetry), Assay of copper sulphate (Iodometry), Assay of Potassium iodide (Iodate titration) • Balancing of redox equation-half cell reaction and net reaction	**06**
5	**UNIT 5**	**08**
5.1	• Electrochemical cell • Electrolytic cell/Galvanic cell • Electrodes- anode and cathode • Cathode reaction, anode reaction • Faraday and non-faraday current • **Conductometry-** Introduction, Conductivity cell, Conductometric titrations, applications.	**02**

5.2	**Potentiometry** – • Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration • Construction and working of glass electrode and pH meter/potentiometer • Applications: Titration of Strong acid -strong base, weak acid-strong base	**03**
5.3	**Polarography** – • Apparatus-Construction and working of Dropping mercury electrode and rotating platinum electrode (DME), advantages and disadvantages of DME • Principle-Current-Voltage curve (Polarogram), supporting electrolyte, Oxygen wave, polarographic maxima • Ilkovic equation, factors affecting limiting current, half wave potential. • Pulse polarography-Normal pulse polarography, Differential pulse polarography and square wave polarography) • Applications	**02**
5.4	**Aquametry by Karl Fischer titration:** • Principle, composition, and stability of KFR, standardization of KFR as per I.P, • Application: Determination of water in a sample-e.g. Amoxycillin trihydrate.	**01**
	Total Hours	**45**

Recommended Books (Latest Editions)

1. Practical Pharmaceutical Chemistry by Beckett, A H & Stenlake, J B, 2005, 4thedition, Part I and II, CBS Publishers and Distributors, India.
2. A Textbook of Pharmaceutical Analysis by Kenneth A Connors, 2002, 3rd edition, John Wiley and Sons, Canada.
3. Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, 1992, 5thedition, Saunders College Publishing, USA.
4. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, 1991, 7th edition, Saunders College Publishing, USA.
5. Analytical Chemistry by Gary D. Christian, 6th edition, John Wiley & Sons, Singapore.
6. Vogel's Textbook of Quantitative Chemical Analysis by Mendham J, R.C. Denney, J.D. Barnes, M. Thomas, 2002, 6th edition, Pearson Education Ltd.
7. Pharmaceutical Drug Analysis by Ashutosh Kar, 2005, 2nd edition, New Age International (P) Ltd Publishers, India.
8. Instrumental Methods of Analysis by S. S. Mahajan, 2010, 1st edition, Popular Prakashan Pvt Ltd, India.

9. Instrumental Methods of Chemical Analysis (Analytical Chemistry) by Gurudeep R. Chatwal and Sham. K. Anand, 2008, 5th revised and enlarged edition, Himalaya Publishing House Pvt Ltd.
10. Indian Pharmacopoeia, Latest Edition
11. Instrumental Method of Analysis by Willard H.H., L. L. Merritt& John A. Dean, 1986, 6th edition, CBS Publishers & Distributors, New Delhi
12. Undergraduate Instrumental Analysis by J.W. Robinson, E.M. Skelly Frame and G.M. Frame II, Pub. Marcel Deckker, 2009
13. Analytical Chemistry, 2nd edition, R. Kellnar, M. Mermet, M. Otto, M. Valcarcel, H. M. Widner.

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Course code	Course Name	Credits
BP103T	**Pharmaceutics I – Theory**	**4**

- **Prerequisites**
  - Fundamental knowledge of physical chemistry and basics such as weights, measures

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Know different Pharmacopoeias, various monophasic and biphasic, liquid and semisolid dosage forms, prescription and compatibilities.
  2. Explain evaluation of solutions, suspensions, and emulsions, semisolid dosage forms suppositories
  3. Perform related calculations and prepare liquid and semisolid dosage forms.
  4. Analyze the errors in the prescription and identify physical and chemical incompatibilities among different active ingredients.
  5. Devise the composition of monophasic and biphasic dosage forms, considering the pharmaceutical incompatibilities.

Sr. No.	Content	Hours
1	**UNIT I**	**10**
1.1	Historical background and development of profession of pharmacy: History of Pharmacy profession in India in relation to pharmacy education, industry and organization, Pharmacy as a career Understanding Pharmaceutical Industry, Key players, allied fields and market	**02**
1.2	Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.	**02**
1.3	Dosage forms: Introduction to dosage forms, classification and definitions	**02**
1.4	Prescription: Definition, Parts of prescription, handling of Prescription and Errors in prescription.	**02**
1.5	Posology: Definition, Factors affecting posology; Paediatric dose calculations based on age, body weight and body surface area.	**02**
2	**UNIT 2**	**10**
2.1	Pharmaceutical calculations: Weights and measures – Imperial & Metric system Calculations involving percentage solutions, allegation, proof spirit and isotonic solutions based on freezing point and molecular weight. Self-Study: Imperial system	**03**
2.2	Powders: Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.	**04**
2.3	Liquid dosage forms: Advantages and disadvantages of liquid dosage forms.	**03**

	Excipients used in formulation of liquid dosage forms. Solubility enhancement technique	
3	**UNIT 3**	**10**
3.1	Monophasic liquids: Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.	**03**
3.2	Biphasic liquids: Suspensions: Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems. Methods to overcome instability in suspensions. Self-Study: Methods to overcome instability in suspensions	**04**
3.3	Emulsions: Definition, classification, emulsifying agent, test for the identification type of Emulsion, Methods of preparation & stability problems. Methods to overcome instability in emulsions. Self-Study: Methods to overcome instability in emulsions	**03**
4	**UNIT 4**	**08**
4.1	Suppositories: Definition, types, advantages and disadvantages	**01**
4.2	types of bases and methods of preparations.	**02**
4.3	Displacement value & its calculations, evaluation of suppositories.	**02**
4.4	Pharmaceutical incompatibilities: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.	**03**
5	**UNIT 5**	**07**
5.1	Definitions, classification, mechanisms and factors influencing dermal penetration of drugs.	**03**
5.2	Preparation of ointments, pastes, creams and gels.	**04**
	Total Hours	**45**

Recommended Books (Latest Editions)

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

8. Carter S.J., Cooper and Gunn ‘s. Tutorial Pharmacy, CBS Publications, New Delhi.
9. E.A. Rawlins, Bentley’s Textbook 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.

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Course code	Course Name	Credits
BP104T	**Pharmaceutical Inorganic Chemistry – Theory**	**4**

- **Prerequisites**
  - Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions, in terms of loss and gain of electrons and change in oxidation number.
  - Ionic equilibrium: Ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionization of polybasic acids, acid strength, concept of pH, Hydrolysis of salts (elementary idea). Buffer solutions, solubility product, common ion effect, Henderson equation
  - Preparation and properties on hydrogen peroxide, sodium hydrogen carbonation and potassium permangnate

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Describe the principles and methods of limit tests to control common impurities in pharmaceutical substances.
  2. Explain different pharmaceutical buffers, their preparations, uses in pharmaceutical systems, and measurement of tonicity.
  3. Explain the medicinal importance of pharmaceutical inorganic compounds.

Note: General methods of preparation, assay for the compounds superscripted with asterisk (*), properties and medicinal uses of inorganic compounds belonging to the following classes to be studied.		
Sr. No.	**Content**	**Hours**
1	**UNIT 1**	**04**
1.1	**Impurities in pharmaceutical substances:** History of Pharmacopoeia, Sources and types of impurities, the principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate	**04**
2	**UNIT 2**	**11**
2.1	**Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.	**04**
2.2	**Major extra and intracellular electrolytes:** Functions of major physiological ions, **Electrolytes used in the replacement therapy:** Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid-base balance.	**05**
2.3	**Dental products:** Dentifrices, the role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.	**02**
3	**UNIT 3**	**13**
3.1	**Acidifiers:** Ammonium chloride* and Dil. HCl	**02**

3.2	**Antacid:** Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminium hydroxide gel, Magnesium hydroxide mixture	**04**
3.3	**Cathartics:** Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite	**02**
3.4	**Antimicrobials:** Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations	**05**
4	**UNIT 4**	**10**
4.1	**Expectorants:** Potassium iodide, Ammonium chloride*.	**02**
4.2	**Emetics:** Copper sulphate*, Sodium potassium tartrate	**03**
4.3	**Haematinics:** Ferrous sulphate*, Ferrous gluconate	**02**
4.4	**Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite	**02**
4.5	**Astringents:** Zinc Sulphate, Potash Alum	**01**
5	**UNIT 5**	**07**
5.1	**Radiopharmaceuticals:** Radioactivity, Measurement of radioactivity, Properties of α, β, γ radiations, Half-life, radioisotopes and study of radioisotopes - Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances.	**07**
	Total hours	**45**

Recommended Books (Latest Editions)

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of the University of London, 4th edition.
2. A.I. Vogel, Textbook of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd Edition
4. Inorganic Medicinal and Pharmaceutical Chemistry by Block, Roche, Soine and Wilson
5. Bentley and Driver's Textbook of Pharmaceutical Chemistry
6. Anand & Chatwal, Inorganic Pharmaceutical Chemistry
7. Indian Pharmacopoeia

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Course code	Course Name	Credits
BP105T	**Communication Skills – Theory***	**2**

- **Prerequisites**
  - Basic knowledge about various ethics of communication, leadership attitude, and other soft skills required for better communication.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand the behavioral needs for a pharmacist to function effectively in the areas of pharmaceutical operation.
  2. Effectively develop presentation skills with confidence to crack interviews.
  3. Effectively manage the team as a team player. Apply skills learnt to confidently stand in a group discussion.
  4. Apply skills learnt to communicate effectively technically/businesswise.

Sr. No.	Content	Hours
1	**UNIT 1**	**05**
1.1	**Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process- Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context.	**05**
1.2	**Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers.	
1.3	**Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment.	
2	**UNIT 2**	**07**
2.1	**Elements of Communication:** Introduction, Face to Face Communication - Tone of Voice, Body language (Non-verbal communication), Verbal Communication, Physical Communication. 1 activity to be conducted to explain the different elements of communication.	**07**
2.2	**Communication Styles:** Introduction, The Communication Styles Matrix with example for each –Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style Explain the different styles of communication – passive, aggressive, assertive, manipulative. Effective communication style for a corporate / industry setup. Interaction with Patients, and medical professionals (Role Play).	

2.3	Public Speaking: Introduction, methodology in speaking, Importance of confidence vocabulary in public speaking Precis Writing - Concept and rules with examples 1 activity to be conducted – Elocution / any other relevant activity.	
3	**UNIT 3**	**09**
3.1	**Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations Communication	**09**
3.2	**Effective Written Communication:** Introduction, When and When Not to Use Written communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication	
3.3	**Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message	
3.4	**Technical Communication:** What is technical communication, difference between research and review paper, basics of how to write a research / review paper, need for referencing, different styles of referencing, software used for referencing, ethical use of ChatGPT / Artificial Intelligence	
4	**UNIT 4**	**07**
4.1	**Interview Skills:** Purpose of an interview, Do's and Dont's of an interview, pre-interview preparation (attire, documentation, body language, literature), resume writing, essentials during an interview (body language, communication language, technical knowledge), Do's and don'ts during a telephonic / online interview. **Mock Interview:** Each student to face an interview and to demonstrate the above taught skills	**07**
4.2	**Giving Presentations:** Dealing with Fears, planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery, Use of Canva and Graphics in a presentation. **Assignment:** Oral presentations by the students, followed by discussion	
5	**UNIT 5**	**02**
5.1	**Group Discussion:** Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion	**02**
	Total Hours	**30**

Recommended Books (Latest Editions)

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, 1 stEdition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, 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

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Course code	Course Name	Credits
BP106RBT	**Remedial Biology – Theory***	**2**

- **Prerequisites**
  - Basic knowledge about cells, evolution of the living world, classification of kingdoms.
  - Basic knowledge of plant and animal body parts and their functions.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand the cell biology (Basic Nature of Plant cell and Animal cell) and Classification System of both Plants & Animals
  2. Learn and comprehend various tissue systems and organ systems in plants and animals.
  3. Understand and explain anatomy and Physiology of plants and animals.

Sr. No.	Content	Hours
1	**UNIT I**	**07**
1.1	**Living world:** Definition and characters of living organisms Diversity in the living world Binomial nomenclature Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus.	**04**
1.2	**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 & Dicotyledones.	**03**
2	**UNIT 2**	**07**
2.1	**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 Human alimentary canal and digestive glands Role of digestive enzymes Digestion, absorption and assimilation of digested food	**04**
2.2	**Breathing and respiration** Human respiratory system Mechanism of breathing and its regulation Exchange of gasses, transport of gasses and regulation of respiration Respiratory volumes	**03**
3	**UNIT 3**	**07**
3.1	**Excretory products and their elimination**	**02**

	Modes of excretion Human excretory system- structure and function Urine formation Renin angiotensin system	
3.2	**Neural control and coordination** Definition and classification of the 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	**02**
3.3	**Chemical coordination and regulation** Endocrine glands and their secretions Functions of hormones secreted by endocrine glands	**02**
3.4	**Human reproduction** Parts of the female reproductive system Parts of the male reproductive system Spermatogenesis and Oogenesis Menstrual cycle	**01**
4	**UNIT 4**	**05**
4.1	**Plants and mineral nutrition:** Essential mineral, macro, and micronutrients Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation	**03**
4.2	**Photosynthesis:** Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.	**02**
5	**UNIT 5**	**04**
5.1	**Plant respiration.** Respiration, glycolysis, fermentation (anaerobic)	**01**
5.2	**Plant growth and development.** Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators	**01**
5.3	**Cell - The unit of life** Structure and functions of cell and cell organelles. Cell division	**01**
5.4	**Tissues** Definition, types of tissues, location, and functions	**01**
	TOTAL	**30**

Recommended Books (Latest Editions)

1. Textbook of Biology by S. B. Gokhale
2. A Textbook of Biology by Dr. Thulajappa and Dr. Seetaram.
3. A Textbook of Biology by B.V. Sreenivasa Naidu
4. A Textbook of Biology by Naidu and Murthy

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

Course code	Course Name	Credits
BP106RMT	**Remedial Mathematics – Theory***	**2**

- **Prerequisites**
  - Students should possess knowledge of basic mathematics and calculus.
- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand the theoretical concepts of various topics and their application in Pharmacy.
  2. Solve the different types of pharmaceutical problems by applying theoretical concepts.
  3. Appreciate the important application of mathematics and statistics in Pharmacy.

Sr. No.	Content	Hours
1	**UNIT 1: Partial fraction, Logarithms, Function, Limits and continuity**	**06**
1.1	Partial fraction: Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics	**02**
1.2	Logarithms: Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.	**02**
1.3	Function: Real Valued function, Classification of real valued functions	**01**
1.4	Limits and continuity: Introduction, Limit of a function, Definition of limit of a function	**01**
2	**UNIT 2: Matrices and Determinant**	**06**
2.1	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, Application of Matrices in solving Pharmacokinetic equations	**06**
3	**UNIT 3: Calculus Differentiation**	**06**
3.1	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	**06**
4	**UNIT 4: Analytical Geometry**	**06**

4.1	**Introduction:** Signs of the Coordinates, Distance formula	**01**
4.2	**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	**02**
4.3	**Integration:** Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application	**03**
5	**UNIT 5**	**06**
5.1	**Differential Equations:** Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations	**03**
5.2	**Laplace Transform:** Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, Application in solving Chemical kinetics and Pharmacokinetics equations	**03**
	Total Hours	**30**

Recommended Books (Latest Editions)

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

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Course Code	Course Name	Credits
BP107P	**Human Anatomy & Physiology I - Practical**	**2**

- **Prerequisites:**
  - Basic concepts about tissues and its types
  - Blood and its functions
  - Parts of microscope and skeletal system
- **Course Outcomes: After completion of this course students should be able to:**
  1. Explain the parts of the microscope, apply this knowledge to study histology of different tissues and organs.
  2. Explain the components of the skeletal system and identify and describe each part in detail.
  3. Explain the techniques utilized in diagnosing diseases through hematological tests such as bleeding time, clotting time, clot lysis, hemocytometer, and erythrocyte sedimentation rate (ESR), along with the underlying principles of these methods.
  4. Explain the core principles of the cardiovascular system, including methods for assessing heart rate, pulse rate, and blood pressure, and elucidate the roles and applications of pacemakers and implantable cardioverter-defibrillators (ICDs).
  5. Plan, execute and conclude the experiment using various methodologies.

Sr. No.	Content
1.	Study of a compound microscope.
2	Microscopic study of muscular and nervous tissue (Self-Study)
3.	Microscopic study of epithelial and connective tissue. (Self-Study)
4.	Identification of axial & appendicular bones
5.	Introduction to hemocytometer.
6.	Enumeration of white blood cell (WBC) count.
7.	Enumeration of total red blood corpuscles (RBC) count.
8.	Determination of bleeding time.
9.	Determination of clotting time.
10	Study of the Clot-Lysis Activity of blood samples.
11.	Estimation of hemoglobin content.
12.	Determination of blood group.
13.	Determination of blood sugar level.
14.	Determination of erythrocyte sedimentation rate (ESR).
15.	Determination of heart rate and pulse rate and Interpretation of an ECG report
16.	Recording of blood pressure.
17	Introduction to the working of Pacemaker & Implantable cardioverter-defibrillator (ICD).

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. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A

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Course code	Course Name	Credits
BP108P	**Pharmaceutical Analysis I - Practical**	**2**

- **Prerequisites**
  - Fundamental knowledge of chemistry concepts and laboratory techniques, along with proficiency in mathematical calculations

- **Course Outcomes**
  1. Apply principles of titrimetric analysis and limit tests, for standard solution preparation, endpoint prediction, indicator selection, factor determination, impurity detection and calculate percent purity and assay of an analyte
  2. Prepare a protocol for performing bulk drug/ formulation assay using titrimetric analysis using acid-base, redox, non-aqueous acid-base, precipitation and complexation reactions.
  3. Plan, execute and conclude the experiment using qualitative or quantitative techniques

Sr. No.	Content
i.	**Ability enhancement:** Calibration and Handling of a. Volumetric glass apparatus: Volumetric flask, pipette, burette, fixed volume micropipette b. Equipments/instruments: pH meter
Limit test of the following: (Demonstration)	
1.	Chloride
2.	Sulphate
3.	Iron
4.	Arsenic
Preparation and Standardization of:	
5.	Sodium hydroxide
6.	Sulphuric acid
7.	Sodium thiosulphate
8.	Potassium permanganate
9.	Ceric ammonium sulphate
Assay of the following compounds along with Standardization of Titrant	
10.	Ammonium chloride by acid base titration
11.	Ferrous sulphate by Cerimetry
12.	Copper sulphate by Iodometry
13.	Calcium gluconate by complexometry
14.	Hydrogen peroxide by Permanganometry
15.	Sodium benzoate by non-aqueous titration
16.	Sodium Chloride by precipitation titration
Determination of Normality by electro-analytical methods	

17.	Conductometric titration of strong acid against strong base
18.	Conductometric titration of strong acid and weak acid against strong base
19.	Potentiometric titration of strong acid against strong base
20	Assay of Sulfacetamide sodium using external indicator **(Demonstration)**
21.	**Skill enhancement**: Study of monograph and preparation of protocol for performing titration

Recommended Books (Latest Editions)

1. Indian Pharmacopoeia, Latest edition.
2. Practical Pharmaceutical Chemistry by Beckett, A H & Stenlake, J B, 2005, 4th edition, Part I and II, CBS Publishers and Distributors, India.
3. Analytical Chemistry by Gary D. Christian, 6th edition, John Wiley & Sons,
4. Singapore.
5. Vogel's Textbook of Quantitative Chemical Analysis by Mendham J, R.C. Denney, J.D. Barnes, M. Thomas, 2002, 6th edition, Pearson Education Ltd.
6. Pharmaceutical Analysis –A Textbook for Pharmacy Students and Pharmaceutical Chemists by David G Watson.

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Course code	Course Name	Credits
BP109P	**Pharmaceutics I –Practical**	**2**

- **Prerequisites**
  - Basic knowledge of various dosage forms available in the market, weights, and measures.

- **Course Outcomes**
  1. Prepare monophasic, biphasic, powders and semi solid systems, justify the components and method of preparation.
  2. Perform experiments as per GLP and record in the journals
  3. Plan, execute and conclude the experiment using various methodologies (defined protocol or qualitative or quantitative techniques).

Sr. No.	Content
1	**Syrup**
1.1	Syrup IP'66
1.2	Compound syrup of Ferrous Phosphate BPC'68
2	**Elixirs**
2.1	Piperazine citrate elixir
2.2	Paracetamol pediatric elixir
3	**Linctus**
3.1	Terpin Hydrate Linctus IP'66
3.2	Iodine Throat Paint (Mandle's Paint)
4	**Solutions**
4.1	Strong solution of ammonium acetate
4.2	Cresol with soap solution
4.3	Lugol's solution
5	**Suspensions**
5.1	Calamine lotion
5.2	Magnesium Hydroxide mixture
5.3	Aluminum Hydroxide gel
6	**Emulsions**
6.1	Turpentine Liniment
6.2	Liquid paraffin emulsion
7	**Powders and Granules**
7.1	ORS powder (WHO)
7.2	Effervescent granules
7.3	Dusting powder
7.4	Divided powders
8	**Suppositories**
8.1	Glycero gelatin suppository

8.2	Cocoa butter suppository
8.3	Zinc Oxide suppository
9	**Semisolids**
9.1	Sulphur ointment
9.2	Non-staining-iodine ointment with methyl salicylate
9.3	Carbopol gel
10	**Gargles and Mouthwashes**
10.1	Iodine gargle
10.2	Chlorhexidine mouthwash
11	Demo of single punch tablet machine.

Recommended Books (Latest Editions)

1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi.
2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.
3. M.E. Aulton, Pharmaceutics, The Science & Dosage Form Design, Churchill Livingstone, Edinburgh.
4. Indian pharmacopeia.
5. British pharmacopeia.
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 Textbook 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

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Course code	Course Name	Credits
BP110P	**Pharmaceutical Inorganic Chemistry –Practical**	**2**

- **Prerequisites**
  - Basic knowledge of handling of chemicals, and elemental analysis.

- **Course Outcomes**
  1. Perform qualitative analysis of given inorganic mixtures.
  2. Carry out identification test of given inorganic compounds.
  3. Perform limit test for chlorides, sulphates, iron, Lead heavy metals etc.
  4. Prepare inorganic compounds.

Sr. No.	Content
1	• 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
2	Identification test for • Magnesium hydroxide • Ferrous sulphate • Sodium Bicarbonate • calcium gluconate • copper sulphate
3	Swelling power of Bentonite
4	Neutralizing capacity of aluminium hydroxide gel
5	Determination of potassium iodate and iodine in potassium Iodide
6	Inorganic Synthesis of Boric acid
7	Inorganic Synthesis of Potash alum
8	Inorganic Synthesis of Ferrous sulphate

Recommended Books (Latest Editions)

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

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Course code	Course Name	Credits
BP111P	**Communication skills –Practical***	**1**

- **Prerequisites**
  - Basic knowledge of using Computer software, using Microsoft presentation, interview background etc.

- **Course Outcomes**
  1. Practice the Basic Communication attributes required during meeting people, making friends, asking questions using Wordsworth® English language lab software.
  2. Learn the Advanced techniques involved in effective communication, writing skills, interview handling skills, presentation skills, E-mail writing using Wordsworth® English language lab software.
  3. Plan, execute and conclude the tasks using various methodologies (defined protocol or qualitative or quantitative techniques).

Sr. No.	Content
1	**Basic communication covering the following topics**
1.1	• Meeting People • Asking Questions • Making Friends • What did you do? • Do's and Dont's
2	**Pronunciations covering the following topics**
2.1	• Pronunciation (Consonant Sounds) • Pronunciation and Nouns • Pronunciation (Vowel Sounds)
3	**Advanced Learning**
3.1	• Listening Comprehension / Direct and Indirect Speech • Figures of Speech • Effective Communication (Wordsworth Software) • Writing Skills • Effective Writing • Interview Handling Skills • E-Mail etiquette • Presentation Skills • Comprehension Reading & Analysis • Debate / Elocution • Mock Interview • Presentations (Technical / non-technical) • Poster Designing • Advertisement designing

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Recommended Books (Latest Editions)

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, 1 stEdition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, 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

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Course code	Course Name	Credits
BP112RBP	**Remedial Biology – Practical***	**1**

- **Prerequisites**
  - Prior knowledge about cell biology, morphology of plants, anatomy of bones.
  - Basic understanding of concepts of blood pressure,blood group and respiratory volumes

- **Course Outcomes**
  1. Demonstrate Handling of microscope independently & able to demonstrate understanding of section cutting techniques, mounting and staining, permanent slide preparation. Able to apply this knowledge to study histology of different tissues and organs of plants and animals.
  2. Understand and explain morphology of plant concerning stem, root, leaf and its modification.
  3. Identify the bones and understand and explain about determination of blood group, blood pressure, tidal volume which basal characteristics are commonly assessed during physical examination for clinical diagnosis.
  4. Explain the different diagnostic reports analysis.
  5. Plan, execute and conclude the experiment using various methodologies.

Sr. No.	Content
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 frogs by using computer models. (Self-Study)
4.	Demonstration of Diagnostic Report Analysis
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

Recommended Books (Latest Editions)

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.Srivastava.
3. Biology practical manual according to the National core curriculum. Biology forum of Karnataka. Prof .M.J.H.Shafi.

Semester II

Course Code	Course Name	Credits
BP201T	Human Anatomy and Physiology II - Theory	4

- **Prerequisites:**
  - Basic knowledge of biology, commonly used terminologies in anatomy, physiology and pathophysiology.
  - Concepts of homeostasis, feedback mechanisms, mitosis and meiosis, dietary constituents, and transport across cell membrane

- **Course Outcomes: After completion of this course students should be able to:**
  1. Describe and illustrate the anatomical features of the Nervous System, Respiratory system, Digestive system, Reproductive System and Urinary system and demonstrate an understanding of the physiology of the same.
  2. Analyze the diversity, distribution, and recent advances in understanding the human microbiome across various body sites and apply this knowledge to critically evaluate clinical case studies, identifying microbiome-related factors influencing health outcomes.
  3. Demonstrate a comprehensive understanding of stress physiology and sports physiology, including the physiological responses to stressors, exercise, sports and their impact on the body. Additionally, students will be able to suggest strategies for effectively managing stress, empowering them to promote optimal health and well-being.
  4. Apply their understanding of human anatomy and physiology to diverse fields such as healthcare, research, and wellness promotion.

Sr. No.	Content	Hours
1	**Unit 1: Nervous system Part 1**	10
1.1	Organization of nervous system, neuron, neuroglia, classification and properties of nerve fiber, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.	04
1.2	**Central nervous system:** Meninges, ventricles of brain and cerebrospinal fluid. Structure and functions of brain (cerebrum, brain stem, and cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity). Clinical case studies	06
2	**Unit 2: Nervous system Part 2**	13
2.2	**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. Case studies and clinical applications	06
2.3	**Special senses**	01

	Structure and functions of the eye, ear, nose, and tongue. Case studies and clinical applications (Self Study).	
3	**Unit 3: Stress and Sports Physiology**	**06**
3.1	**Stress physiology & its management.**	**03**
3.2	**Sports physiology** Muscles in exercise, CVS in exercise, body heat in exercise, body fluid and salts in exercise. Clinical case studies.	**03**
4	**Unit 4: Digestive system and Energetics**	**06**
4.1	**Digestive System** Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, Enteric Nervous system, 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 Carbohydrates, Fats & Proteins, Integration of digestive reflexes, Migrating Motor Complex, secretion of Isotonic NaCl solution & bicarbonates. Clinical case studies.	**04**
4.2	**Energetics**: Formation and role of ATP, Creatine Phosphate, and BMR (Self-Study)	**Self-Study**
4.2	**Human Microbiome** Discovery, Microbiome: GI tract, Oral, Skin, Lung, Recent advances. Case studies and clinical applications.	**02**
5	**Unit 5: Respiratory System and Urinary System**	**10**
5.1	**Respiratory system** Anatomy of the respiratory system with special reference to the anatomy of lungs. Mechanism of respiration, regulation of respiration Lung Volumes and capacities transport of respiratory gasses, artificial respiration, and resuscitation methods. Clinical case studies	**05**
5.2	**Urinary system** Anatomy of the urinary tract with special reference to the anatomy of kidney and nephrons,Types of nephrons. Functions of kidney and urinary tract, physiology of urine formation,Counter Current mechanism, role of kidneys in acid-base balance, Fluid & Electrolyte balance (Osmoregulation) the role of RAS in kidney,micturition reflex and disorders of kidney. Clinical case studies.	**05**
6	**Unit 6: Reproductive System**	**06**
6.1	**Reproductive system** Anatomy of the male and female reproductive system, Functions of the male and female reproductive system, sex hormones, physiology of	**06**

	menstruation, fertilization, spermatogenesis, oogenesis, pregnancy, and parturition. Clinical case studies.	
6.2	**Introduction to genetics** Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance (Self Study).	
	Total Hours	**45**

Recommended Books (Latest Editions)

1. Tortora, G.J. and Grabowski, S.R., 2005. Principles of Anatomy and Physiology. HarperCollins College Publishers, New York
2. Guyton, A.C., Textbook of Medical Physiology. W. B. Saunders Co., Philadelphia, USA.
3. Waugh, Anne, Grant, Allison. (2006). Ross and Wilson anatomy and physiology in health and illness (10th , 11th ,12th). Toronto: Churchill Livingstone/Elsevier.
4. Godkar P.B and Godkar D.P., Textbook of Medical Laboratory Technology. Bhalani Publishing House, MumbaiGoyal, R.K., Patel, N.M. and Shah, S.A., Practical Anatomy, Physiology and Biochemistry. B. S. Shah Prakashan, Ahmedabad.
5. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
6. Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.

Recommended Articles:

1. Fogelman N and Canli T (2019) Early Life Stress, Physiology, and Genetics: A Review. Front. Psychol. 10:1668. doi: 10.3389/fpsyg.2019.01668, https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2019.01668/full
2. Patel PN, Zwibel H. Physiology, Exercise. [Updated 2022 Sep 12]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK482280/
3. Bordoni B, Sugumar K, Varacallo M. Muscle Cramps. [Updated 2023 Aug 4]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK499895/
4. Jakeman PM, Winter EM, Doust J. A review of research in sports physiology. J Sports Sci. 1994 Feb;12(1):33-60. doi: 10.1080/02640419408732157. PMID: 8158747. https://pubmed.ncbi.nlm.nih.gov/8158747/
5. Kothari, Ruchi; Sharma, Snigdha1. Sports Physiology – An Upcoming Avenue. Journal of Mahatma Gandhi Institute of Medical Sciences 24(1):p 9-12, Jan–Jun 2019. | DOI: 10.4103/jmgims.jmgims_7_19 https://journals.lww.com/mgim/fulltext/2019/24010/sports_physiology___an_upcoming_avenue.4.aspx
6. Chu B, Marwaha K, Sanvictores T, et al. Physiology, Stress Reaction. [Updated 2024 May 7]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK541120/

7. Bruce S. McEwen, Physiology and Neurobiology of Stress and Adaptation: Central Role of the Brain, Physiol Rev 87: 873–904, 2007; doi:10.1152/physrev.00041.2006

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Course code	Course Name	Credits
BP202T	**Pharmaceutical Organic Chemistry-I Theory**	**4**

- **Pre-requisites**
  - Classification of organic compounds and basic rules of nomenclature

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Classify and give IUPAC nomenclature of various organic compounds along with the type of isomerism present.
  2. Describe and explain the hybridization & stability in alkanes, alkenes & conjugated dienes along with the elimination, electrophilic & free radical addition reactions in alkenes with orientation.
  3. Describe and explain the different nucleophilic substitution & addition reactions in Alkyl halides & Carbonyl compounds and stereochemistry.
  4. Describe and explain the method of preparation, reactions, chemical properties, uses, structures & the qualitative identification tests for compounds of different functional groups like alcohols, carbonyl compounds, carboxylic acids, aliphatic amines.

Note: 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

Sr. No.	Course Content	Hours
1	**Unit 1: Classification, nomenclature and isomerism**	**04**
1.1	Classification of Organic Compounds, Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbon open chain and carbocyclic compounds)	**05**
1.2	Structural isomerisms in organic compounds.	**02**
2	**Unit 2: Alkanes*, Alkenes*, and Conjugated dienes***	**10**
2.1	SP^3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins., Stabilities of alkenes, SP^2 hybridization in alkenes	**04**
2.2	E_1 and E_2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeff orientation, and evidence. E_1 versus 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	**04**
2.3	Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement	**02**
3	**Unit 3: Alkyl Halides* & Alcohols***	**10**
3.1	**Alkyl halides-** SN_1 and SN_2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations, SN_1	**07**

	versus SN_2 reactions, Factors affecting SN_1 and SN_2 reactions, Structure and uses of ethyl chloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.	
3.2	**Alcohols-** Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol	**03**
4	**Unit 4: Carbonyl compounds* (Aldehydes and ketones)**	**10**
4.1	Nucleophilic addition, Electromeric effect	**02**
4.2	Name reactions: aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation,	**07**
4.3	Qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanillin, Cinnamaldehyde	**01**
5	**Unit 5: Carboxylic acids* & Aliphatic amines***	**10**
5.1	**Carboxylic acids -** Acidity of carboxylic acids, effect of substituents on acidity, Inductive effect and qualitative tests for carboxylic acids, amide and ester, Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid.	**06**
5.2	**Aliphatic amines -** Basicity, the effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine	**04**
	Total Hours	**45**

Recommended Books (Latest Editions)

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar, Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's textbook of Practical Organic Chemistry

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Course code	Course Name	Credits
BP203T	Biochemistry - Theory	4

- **Pre-requisites**
  - Knowledge of biomolecules and cellular content and functions
  - Idea of energetics and thermochemistry
  - Understanding of organic chemistry and nomenclature

- **Course Outcomes: After the completion of the course, the learner will be able to:**
  1. Understand the classification, structure, and functions of basic biomolecules like Carbohydrates, proteins, lipids, and nucleic acids.
  2. Learn thermodynamic and bioenergetic aspects of biochemical reactions.
  3. Understand the metabolism of Carbohydrates, proteins, lipids and nucleic acids and to reproduce names, structures, products and enzymes involved in all the metabolic processes.
  4. Understand the catalytic role of enzymes, importance of enzyme inhibitors, therapeutic and diagnostic applications of enzymes.
  5. Explain steps of the central dogma of molecular biology i.e. replication, transcription and translation

Sr. No.	Content	Hours
1	**Unit 1**	08
1.1	**BIOMOLECULES** **Carbohydrate:** Introduction, classification, chemical nature and biological role of carbohydrate **Structural aspects of carbohydrates:** Stereoisomerism, D and L isomers, optical activity of sugars, Fischer projection, Epimers, hemiacetal, hemiketal, Haworth projection, Anomers, Enantiomers, mutarotation **Reactions of monosaccharides** **Glycosides:** naming of the glycosidic bond, Reducing, non-reducing disaccharides Examples lactose, maltose, cellobiose, sucrose, inversion of sucrose. **Amino acids and proteins** Introduction, classification, biological role of amino acids and proteins Primary, secondary, tertiary and quaternary structure of proteins **Lipids** Introduction, classification, the biological role of lipids **Fatty acids**-classification and significance Shorthand notation of common fatty acids **Simple Lipids** – Triacylglycerols Fats and oils, Phospholipids	06

	Cholesterol **Combination of molecules:** Glycoproteins, proteoglycans, lipopolysaccharides, glycolipids, lipoproteins, proteolipids, nucleoproteins HDL, LDL and their correlation with blood tests **Nucleic acids** Introduction to nitrogen bases, nucleosides and nucleotides Watson and Crick model of DNA, Melting and annealing of DNA, melting temperature	
1.2	**BIOENERGETICS** Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential	**01**
1.3	Energy-rich compounds; classification; biological significance of ATP and cyclic AMP.	**01**
2	**Unit 2**	**10**
2.1	**CARBOHYDRATE METABOLISM** **Glycolysis** - Pathway, energetics and significance, regulation, Shuttle pathways **PDH Complex -** Role and reactions of PDH Complex **Citric acid cycle -** Pathway, energetics, significance and regulation **HMP shunt** and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency **Glycogen metabolism** Pathways, regulation and glycogen storage diseases (GSD) **Gluconeogenesis** - Pathway and its significance, Cori cycle, Glucose-alanine cycle, Regulation Hormonal regulation of blood glucose level and Diabetes mellitus	**08**
2.2	**Biological oxidation** Electron transport chain (ETC) and its mechanism Oxidative phosphorylation & its mechanism and substrate level phosphorylation Inhibitors of ETC and oxidative phosphorylation/Uncouplers	**02**
3	**Unit 3**	**10**
3.1	**Lipid metabolism** β-Oxidation of saturated fatty acid (Palmitic acid) Formation and utilization of ketone bodies; ketoacidosis De novo synthesis of fatty acids (Palmitic acid) Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity	**05**
3.2	**Amino acid metabolism** General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders	**05**

	Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenylketonuria, Albinism, alkaptonuria, tyrosinemia) Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline Catabolism of heme; hyperbilirubinemia and jaundice	
4	**Unit 4**	**10**
4.1	**Nucleic acid metabolism and genetic information transfer** Biosynthesis of purine and pyrimidine nucleotides Catabolism of purine and pyrimidine nucleotides Disorders of purine and pyrimidine metabolism: Hyperuricemia, Gout disease, Orotic aciduria and Reye's syndrome Organization of mammalian genome Structure of DNA and RNA and their functions DNA replication in prokaryotes (semi-conservative model) Transcription or RNA synthesis Genetic code Translation or Protein synthesis and inhibitors	**10**
5	**Unit 5**	**07**
5.1	**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 enzyme regulation Therapeutic and diagnostic applications of enzymes and isoenzymes Coenzymes – Structure and biochemical functions	**07**
	Total Hours	**45**

Recommended Books (Latest Editions)

1. Biochemistry by D. Satyanarayan and U.Chakrapani.
2. Principles of Biochemistry by Lehninger.
3. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.
4. Essentials of Biochemistry by Pankaja Naik.
5. Biochemistry by Stryer.
6. Outlines of Biochemistry by Conn and Stumpf.

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Recommended Articles

1. Chandel NS, Carbohydrate metabolism, Cold Spring Harbor Perspectives in Biology, 2021;13:a040568.
2. Chandel NS, Nucleotide Metabolism, Cold Spring Harbor Perspectives in Biology, 2021;13:a040592.

Course Code	Course Name	Credits
BP204T	**Pathophysiology – Theory**	**4**

- **Prerequisites:**
  - Students should possess knowledge about the following:
    - Anatomy and physiology of the different systems in the body
    - Basic knowledge of cell growth

- **Course Outcomes: After completion of this course students should be able to:**
  1. Explain of Principles related to cell injury, adaptation, repair, growth, inflammation and pathogenesis of cancer.
  2. Describe the etiology and pathophysiology of diseases related to cardiovascular, Skeletal, Respiratory, Gastrointestinal, Urinary, Endocrine and Nervous system.
  3. Describe the etiology and pathophysiology of diseases related to infectious diseases.
  4. Apply the knowledge related to diseases and symptoms to identify the disease.

Sr. No.	Content	Hours
1	**Unit 1**	**10**
1.1	**Basic principles of Cell injury and Adaptation:** Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury, Apoptosis, Ferroptosis, Necrosis, 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	**05**
1.2	**Basic mechanism involved in the process of inflammation and repair:** Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC‘s, Mediators of inflammation	**05**
2	**Unit 2**	**10**
2.1	**Cardiovascular system:** Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis), Arrythmia	**04**
2.2	**Respiratory system:** Asthma, Chronic obstructive airways diseases	**04**
2.3	**Renal system:** Acute and chronic renal failure	**02**
3	**Unit 3**	**10**
3.1	**Haematological Diseases:** Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia (Self Study), hemophilia	**03**
3.2	**Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones	**03**

3.3	**Nervous system:** Epilepsy, Parkinson‘s disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer‘s disease.	**03**
3.4	**Gastrointestinal system:** Peptic Ulcer, GERD	**01**
4	**Unit 4**	**08**
4.1	**Inflammatory diseases:** Inflammatory bowel diseases, jaundice, hepatitis (A, B, C, D, E, F), alcoholic liver disease	**03**
4.2	**Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout	**03**
4.3	**Principles of cancer:** Classification, etiology and pathogenesis of cancer	**02**
5	**Unit 5**	**07**
5.1	**Infectious diseases:** Meningitis, Typhoid, SARS, Tuberculosis, Leprosy (Self Study), Urinary tract infections	**04**
5.2	**Sexually transmitted diseases:** AIDS, Syphilis, Gonorrhea	**03**
	Total Hours	**45**

Recommended Books (Latest Editions)

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins & Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.
2. Harsh Mohan; Textbook of Pathology; 6th edition; India; Jaypee Publications; 2010.
3. Guyton A, John .E Hall; Textbook of Medical Physiology; 12th edition; WB Saunders Company; 2010.

Recommended Website: https://www.statpearls.com/

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Course Code	Course Name	Credits
BP205T	**Computer Applications in Pharmacy – Theory***	**3**

- **Pre-requisites**
  - Basic understanding of computer systems and software.
  - Familiarity with fundamental concepts of mathematics and data analysis.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. know the various types of application of computers in pharmacy
  2. know the various types of databases, web technologies, programming languages, MS-Office application
  3. know the various applications of databases in pharmacy

Sr. No.	Content	Hours
1	**Unit 1**	**06**
1.1	Number system: Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement, Two's complement method, binary multiplication, binary division	**03**
1.2	**Concept of Information Systems and Software:** Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project.	**03**
2	**Unit 2**	**09**
2.1	Web technologies: Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products	**03**
2.2	Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database	**03**
2.3	Introduction to MS-Office: Word, Excel, PowerPoint	**03**
3	**Unit 3:**	**06**
3.1	**Application of computers in Pharmacy** –Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring Diagnostic System, Lab-diagnostic System, Patient Monitoring System (Electronic Health Records), Pharma Information System	**06**
4	**Unit 4:**	**04**
4.1	**Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery	**04**
5	**Unit 5:**	**05**

5.1	**Computers as data analysis in Preclinical development:** Chromatographic dada analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS)	**03**
5.1	**Digital Health:** mobile health (mHealth), health information technology (IT), wearable devices, telehealth and telemedicine, and personalized medicine **AI in Healthcare:** Types of AI of relevance to healthcare- Machine learning – neural networks and deep learning, Natural language processing, Rule-based expert systems, Physical robots, Robotic process automation	**02**
	Total Hours	**30**

Recommended Books (Latest Editions)

1. Computer Application in Pharmacy – William E. Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.
2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA
3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002 (INDIA)
4. Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N. Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi – 110002

Recommended Article

Davenport T, Kalakota R. The potential for artificial intelligence in healthcare. Future Healthc J. 2019 Jun;6(2):94-98. doi: 10.7861/futurehosp.6-2-94.

Recommended Webpages

1. https://www.w3schools.com/html/default.asp
2. https://www.w3schools.com/xml/default.asp
3. https://www.w3schools.com/css/default.asp
4. https://www.w3schools.com/mysql/default.asp
5. https://support.microsoft.com/en-us/access
6. https://go.drugbank.com/
7. https://www.accessdata.fda.gov/scripts/cder/ob/index.cfm
8. https://www.1mg.com/labs
9. https://www.webmd.com/
10. https://support.microsoft.com/en-us/word
11. https://support.microsoft.com/en-us/excel
12. https://support.microsoft.com/en-us/powerpoint
13. https://www.fda.gov/medical-devices/digital-health-center-excellence/what-digital-health (accessed 07/06/2024)

Course Code	Course Name	Credits
BP206T	**Environmental sciences – Theory***	**3**

- **Pre-requisites**
  - Understanding of agents and factors that contribute to environmental changes.
  - Knowledge of structure and functioning of major physical and ecological components of the earth's systems

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Describe the basics of Environmental sciences like need and purpose of study the subject, Ecology, food chain and ecological pyramids, sustainable development
  2. Classify and compare different sources of energies
  3. Relate technology to control pollution and economic benefits thereof, infer, the concept of green building, carbon credit and disaster management Realize the environment related moral responsibilities and identify Legal (environmental) aspects for becoming entrepreneur in future

Sr. No.	Content	Hours
1	**Unit 1:**	**09**
1.1	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.	**09**
1.2	Case studies on above topics	
2	**Unit 2**	**09**
2.1	Ecosystems Concept of an ecosystem. Structure and function of an ecosystem. Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	**10**
3	**Unit 3**	**06**
3.1	Environmental Pollution: Air pollution; Water pollution; Soil pollution	**06**
3.2	Case studies on above topics	
4	**Unit 4**	**06**
4.1	E pollution, global warming Impact of Environment on Health Drug Disposal Systems Pharmaceutical Pollution ERA (environmental risk assessment of new molecules chemicals) Sustainability (Green Pharmacy) Introduction to Eco pharmacovigilance	**06**

4.2	Case studies on above topics	
	Total hours	**30**

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 Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India,
5. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
6. Clark R.S., Marine Pollution, Clanderson Press Oxford
7. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
8. De A.K., Environmental Chemistry, Wiley Eastern Ltd. Down of Earth, Centre for Science and Environment

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Course Code	Course Name	Credits
BP207P	**Human Anatomy and Physiology II - Practical**	**2**

- **Prerequisites:**
  - The learner should have basic knowledge about the following:
    - Different systems in the body namely digestive, cardiovascular, reproductive, respiratory, integumentary and nervous system
    - Basic idea about the physiology of the body
- **Course Outcomes: After completion of this course students should be able to:**
  1. Explain fundamental concepts of human physiology, including body temperature regulation, respiratory mechanics, feedback mechanisms, immune responses, and sensory perception, with reference to normal function and deviations from homeostasis.
  2. Apply knowledge of physiological processes to interpret clinical measurements and laboratory data, identifying potential health issues or deviations from normal ranges.
  3. Perform and interpret various physiological assessments, including neurological examinations, visual acuity tests, reflex assessments, and sensory perception tests, to evaluate overall health and function of body systems.
  4. Demonstrate skills in using anatomical models, specimens, and medical equipment to communicate anatomical structures and physiological processes effectively to the stakeholders.
  5. Critically evaluate research literature, clinical case studies, and laboratory findings and draw evidence-based conclusions.

Sr. No.	Content
1	Recording of Body temperature
2	Recording of Tidal volume and Vital capacity
3.	To demonstrate positive and negative feedback mechanisms. (Self-study)
3.	Determination of differential leucocyte count of own blood sample
4.	Recording of basal mass index
5.	To demonstrate the function of the olfactory nerve.
6	To examine the different types of taste.
7.	To demonstrate visual acuity
8	To demonstrate the general neurological examination.
9.	Study of family planning devices and pregnancy diagnosis tests.
10.	Demonstration of total blood count by cell analyzer.
11.	To demonstrate the reflex activity (Self-study)
12.	Tutorial on Various Anesthesia Techniques.
13.	To study the integumentary and special senses using specimen, models, etc.,
14.	Study of Nervous systems with the help of models, charts, and specimens
15.	To study the endocrine system using specimen, models, etc (Self-Study)
16,	Tutorial on Extracorporeal Membrane Oxygenation (ECMO).

17.	Study of digestive, respiratory, urinary, and reproductive systems with the help of models, charts, and specimens. (Self-study)
18.	Tutorial on Deep Brain Stimulation Techniques
19.	Permanent slides of vital organs and gonads.
20.	To demonstrate and train for CPR technique

Recommended Books (Latest Editions)

1. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A
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. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
5. George Maladiski**,** ExtraCorporeal Membrane Oxygenation (ECMO) review of a lifesaving technology Journal Thoracic Dis2015 Jul; 7(7): E166–E176.
6. Corey E. Ventetuolo, Ralf Borchardt, Daniel Brodie.Extracorporeal membrane oxygenation,Mechanical Circulatory and Respiratory Support 2018, Pages 245-269

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Course code	Course Name	Credits
BP208P	**Pharmaceutical Organic Chemistry-I Practical**	**2**

- **Pre-requisites**
  - Handling different sets of laboratory apparatus and basics of safety aspects while working in a chemistry lab

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Practice and follow safety rules & precautionary measures in a laboratory.
  2. Explain theoretical aspects of physical constant determination, detection of functional groups.
  3. Characterize/ Identify monofunctional or bifunctional organic compounds by physical constant, elemental analysis and functional group analysis.
  4. Prepare solid derivatives from organic compounds & molecular model construction of basic organic compounds.
  5. Plan, execute and conclude the experiment using various methodologies (defined protocol or qualitative or quantitative techniques)

Sr. No.	Content
1.	**Preliminary test:** Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc. • Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test Solubility test **Functional group test** like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides. Melting point/Boiling point of organic compounds **Minimum 5** unknown organic compounds to be analysed systematically.
2.	Identification of the unknown compound from the literature using melting point/ boiling point
3	Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point.
4	Separation of Binary Mixture (Solid + Solid) and (Liquid + Liquid)

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

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Course code	Course Name	Credits
BP209P	**Biochemistry - Practical**	**2**

- **Pre-requisites**
  - Basic understanding about the chemical nature of carbohydrates, amino acids, proteins and lipids
  - Knowledge about role of enzyme and substrate, enzyme kinetics and the factors which influence the activity of the enzyme.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Able to perform qualitative and quantitative analysis of various samples of carbohydrates, proteins, lipids, and enzymes.
  2. Estimate enzyme activity concerning various factors Temperature, pH, and substrate concentration and correlate with enzyme-substrate interaction.
  3. Understand clinical applications of biochemical methods through experiments.
  4. Correlate findings with theoretical concepts and conclude the results based on confirmatory tests and calculations.
  5. Demonstrate oral and written communication and ability to plan experiments with proper time management.

Sr. No.	Content
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/ Study the effect of pH on Salivary amylase activity
11.	Study the effect of Temperature on Salivary amylase activity
12.	Study the effect of substrate concentration on salivary amylase activity.

Recommended Books (Latest Editions)

1. 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.

Course code	Course Name	Credits
BP210P	**Computer Applications in Pharmacy – Practical***	**1**

- **Prerequisites**
  - Basic understanding of operating computer systems and software.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Designing and creating, questioners, HTML forms and MS access databases
  2. Apply learning to the problems of pharmaceutical origin

Exp. No.	Title of the Experiment
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
13.	To prepare a powerpoint presentation
14.	To prepare XY scatter plots for given set of data
15.	To create LinkedIn profile and make connections

Recommended Books (Latest Editions)

1. Computer Application in Pharmacy – William E.Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.
2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA
3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)
4. Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N.Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi – 110002

Semester III

Course code	Course Name	Credits
BP301T	**Pharmaceutical Organic Chemistry II-Theory**	**4**

- **Pre-requisites**
  - Basic structures and properties of benzene, fats & oils.

- **Course Outcomes: After the completion of the course, the learner will be able to:**
  1. Recognize and classify different reactions of benzene, phenols, aromatic amines, aromatic acids, polyaromatic compounds, fats/oils, and cyclo-alkane.
  2. Predict aromatic character, and resonance, differentiate compounds based on physicochemical properties (acidity, basicity, and aromaticity and oil-constants), orientation for reaction.
  3. Predict the product, give the mechanism and probable schemes.

Sr. No.	Contents	Hours
1	**Unit 1: Benzene and its derivatives Benzene & its derivatives and Polynuclear hydrocarbons**	**12**
1.1	Analytical, synthetic, and other evidence in the derivation of the structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule	**03**
1.2	Reactions of benzene - nitration, sulphonation, halogenation-reactivity, Friedel crafts alkylation- reactivity, limitations, Friedel crafts acylation. Nucleophilic Aromatic substitution reactions (Mechanistic approach of nucleophilic aromatic substitution (Bimolecular displacement and benzyne formation)	**05**
1.3	Substituents, the effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction	**04**
1.4	Structure and uses of DDT, Saccharin, BHC, and Chloramine (self-study)	**0**
2	**Unit 2: Phenols, Aromatic amines & Aromatic acids**	**10**
2.1	Phenols - Acidity of phenols, the effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols (self-study) Inductive effect and Mesomeric effect on Phenols	**05**
2.2	Aromatic Amines - Basicity of amines, the effect of substituents on basicity, and synthetic uses of aryl diazonium salts	**03**
2.3	Aromatic Acids –Acidity, the effect of substituents on acidity, and important reactions of benzoic acid.	**02**
3	**Unit 3: Fatty acids**	**08**
3.1	Fatty acids – Introduction and classification	**02**
3.2	Reactions- Esterification, halogenation, oxidation, amidation, and general reactions	**03**

	of Fatty acids Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils	
3.3	Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.	**03**
4	**Unit 4: Polynuclear hydrocarbons**	**08**
4.1	Synthesis, reaction Structure, and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane, and their derivatives. (self-Study)	**08**
5	**Unit 5: Cycloalkanes**	**07**
5.1	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.	**07**
	Total Hours	**45**

Recommended Books (Latest Editions)

1. Organic Chemistry by R.T. Morrison and R.N.Boyd, 6th edition, Prentice Hall Publications
2. Organic Chemistry by Pine, Stanley H.; Hendrickson, James B.; Cram, Donald J.; Hammond, George S., 4th edition. The Macgraw Hill publications
3. Clayden
4. Organic Chemistry by I.L. Finar, Vol 1& 2, 6th edition, Pearson Education
5. Organic Chemistry, Part A: Structures and Mechanism, Part B: Reactions and Synthesis, Francis and Carry, Richard J Sundberg. Springer publications
6. Organic Chemistry, Jonathan Clayden, Nick Greeves, and Stuart Warren, Oxford University Press, 2nd Ed., Chapter 6.

Recommended webpages

1. https://byjus.com/chemistry/electrophilic-substitution-reaction-mechanism/#:~:text=In%20electrophilic%20aromatic%20substitution%20reactions,%2C%20and%20Friedel%2DCrafts%20reactions.
2. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(Vollhardt_and_Schore)/15%3A_Benzene_and_Aromaticity%3A_Electrophilic_Aromatic_Substitution/15.05%3A_Polycyclic__Aromatic__Hydrocarbons
3. https://chem.libretexts.org/Courses/Athabasca_University/Chemistry_350%3A_Organic_Chemistry_I/04%3A_Organic_Compounds-_Cycloalkanes_and_their_Stereochemistry/4.01%3A_Naming_Cycloalkanes#:~:text=Cycloalkanes%20are%20alkanes%20with%20carbon,properties%20and%20determining%20its%20reactivity.
4. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/chapt5.htm

Course code	Course Name	Credits
BP302T	**Physical Pharmaceutics I - Theory**	**4**

- **Pre-requisites**
  - The learner should have the basic knowledge of solutions, mixtures, free energy, pH and states of matter.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand various physicochemical properties of drug molecules in the designing of the dosage forms
  2. Describe and distinguish the types of complexes and correlation to drug action and protein binding.
  3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms

Sr. No.	Content	Hours
1	**Unit 1: Solubility of drugs**	**10**
1.1	Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs	**03**
1.2	Dissolution & drug release, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions)	**03**
1.3	Raoult's law, real solutions, azeotropic mixtures, fractional distillation. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications	**04**
2	**Unit 2: States and properties of matter and Physicochemical properties of drug molecules**	**10**
2.1	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	**05**
2.2	Physicochemical properties of drug molecules: Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications	**05**
3	**Unit 3: Surface and interfacial phenomenon**	**10**
3.1	Liquid interface, surface & interfacial tensions, surface free energy	**02**
3.2	Measurement of surface & interfacial tensions	**02**
3.3	Spreading coefficient, Adsorption at liquid interfaces, surface active agents, HLB scale, solubilization	**01**
3.4	Adsorption at liquid interfaces: surface active agents, HLB Scale, solubilisation, detergency,	**03**

3.5	Adsorption at solid interface.	**02**
4	**Unit 4: Complexation and protein binding**	**08**
4.1	Introduction, Classification of Complexation, Applications	**02**
4.2	Methods of analysis	**02**
4.3	Protein binding, Complexation and drug action	**02**
4.4	Crystalline structures of complexes	**01**
4.5	Thermodynamic treatment of stability constants	**01**
5	**Unit 5: pH, buffers and Isotonic solutions**	**07**
5.1	pH determination: electrometric and calorimetric method, applications of buffers **Self-study**: Sorensen ‘s pH scale	**02**
5.2	Buffer capacity **Self-Study**: Buffer equation	**01**
5.3	Buffers in pharmaceutical and biological systems	**02**
5.4	Buffered isotonic solutions.	**02**
	Total Hours	**45**

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, Volume-1 to 3, MarcelDekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical pharmaceutics by Ramasamy C and Manavalan R.
8. Essentials of Physical Chemistry by B.H.Bahl,Arun Bahl and G.D.Tuli

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Course code	Course Name	Credits
BP 303T	**Pharmaceutical Microbiology – Theory**	**4**

- **Pre-requisites**
  - **Basic knowledge of cell biology, biochemistry and Biology**

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand classification and methods of identification, isolation, cultivation and preservation of various classes of microorganisms.
  2. Understand the use of various microscopic techniques, staining techniques and biochemical tests for identification of microorganisms.
  3. Describe various methods for control of microorganisms, their evaluation and factors affecting their efficiency.
  4. Demonstrate various methods used for sterilization of pharmaceutical products and evaluation of efficiency of methods of sterilization.
  5. Describe the cell culture technology and its application in pharmaceutical industry and research.

Sr. No.	Content	Hours
1	**Unit 1: Introduction to Microbiology**	**04**
1.1	Introduction, history of microbiology, its branches, scope and its importance.	**04**
1.2	Introduction to Prokaryotes and Eukaryotes	
1.3	Study of different types of phase contrast microscopy, dark field microscopy and electron microscope	
2	**Unit 2: Study of bacteria, viruses and fungi**	**11**
2.1	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).	**11**
2.2	Identification of bacteria using staining techniques (simple, Gram's & Acid-fast staining) biochemical tests (IMViC). (IMViC can be SELF STUDY)	
2.3	Study of morphology, classification, reproduction /replication and cultivation of Fungi and Viruses.	
2.4	Overview of bacterial, fungal and viral diseases and the pathogens causing them - caused by Mycobacterium sp.(Tuberculosis), Candida sp.(tinea) and coronavirus (SARS-CoV-2) and any other such relevant diseases	
3	**Unit 3: Study of Sterilization techniques**	**14**
3.1	Study of principle, procedure, merits, demerits and applications of	**14**

	physical, chemical gaseous, radiation and mechanical method of sterilization. Survivor curves and concepts of D-value and Z-value. Inactivation factor.	
3.2	Evaluation of the efficiency of sterilization methods, Equipment's employed in large scale sterilization and Sterility indicators.	
3.3	Classification and mode of action of disinfectants, Factors influencing disinfection, antiseptics and their evaluation for bacteriostatic and bactericidal actions, Evaluation of bactericidal & Bacteriostatic. Major groups of disinfectants and antiseptics (with mechanisms and application), chemical sterilants, evaluation of potency – Tube dilution and agar plate methods, phenol coefficient technique, tissue toxicity index	
3.4	Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.	
4	**Unit 4: Industrial applications of Microbiology**	**08**
4.1	Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification as per ISO and USFDA, General aspects of environmental cleanliness and disposal of microbial waste	**08**
4.2	Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids.	
4.3	Assessment of a new antibiotic and testing of antimicrobial activity of a new substance.	
5	**Unit 5: Miscellaneous**	**08**
5.1	Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage.	**08**
5.2	Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.	
5.3	Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures.	
5.4	Application of cell cultures in pharmaceutical industry and research.	
5.5	Disposing of microbial cultures and pathological infectious waste	
	Total Hours	**45**

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, 4 th edition, CBS Publishers & Distributors, Delhi.

3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. I.P., B.P., U.S.P.- latest editions.
10. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
1. Edward: Fundamentals of Microbiology.
11. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
12. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

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Course code	Course Name	Credits
BP304T	**Pharmaceutical Engineering – Theory**	**4**

- **Pre-requisites**
  - Fundamental knowledge on the art and science of various unit operations used in the pharmaceutical industry.
- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand mechanics of fluid, fluid flow, and its measurements
  2. Classify and describe heat measuring devices, mixers and dryers with respect to their applications in pharmacy.
  3. Understand basic principles involved in unit operations such as
  4. crystallization, evaporation, distillation, size reduction, filtration, centrifugation and refrigeration and will be able to describe the equipment and accessories involved therein.
  5. Summarize construction material, discuss corrosion of equipment from pharmaceutical industry point.

Sr. No.	Content	Hours
1	**Unit 1**	**10**
1.1	**Flow of fluids:** Fluid statics, Types of manometers, Fluid dynamics, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturi meter, Pitot tube and Rotameter.	**3**
1.2	**Size Reduction:** Objectives, advantages and disadvantages, applications, Mechanisms & Laws governing size reduction, factors affecting size reduction, classification of equipments-principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill, end runner mill, Planetary ball mill	**3**
1.3	**Size Separation:** Objectives, applications & mechanism of size separation, modes of motion, official standards of powders, types of sieves, specifications for sieve, Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter, sedimentation tank, elutriation tank	**4**
2	**Unit 2**	**10**
2.1	**Evaporation:** Objectives, applications and factors influencing evaporation, differences between evaporation and other heat processes. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, vertical tube evaporator, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator & Economy of multiple effect evaporator.	**3**
2.2	**Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.	**3**

2.3	**Distillation:** Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation,	**4**
3	**Unit 3**	**10**
3.1	**Drying:** Objectives, difference between drying and evaporation, applications & fundamental properties of drying of wet solids, mechanism of drying process-rate of drying curve, measurements & applications, factors affecting Equilibrium Moisture content, classification of dryers: principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer	**5**
3.2	**Mixing:** types of mixtures, mixing process, Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Equipments for solid mixing, Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Equipments for liquid mixing: Impellars: Propellers, Turbines, Paddles & Silverson Emulsifier, Equipments for semisolids mixing; triple roller mill, colloid mill.	**5**
4	**Unit 4**	**8**
4.1	**Filtration:** Objectives, applications, Theories & Factors influencing filtration, mechanism of filtration, types of filtrations, filter aids, filter medium. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seitz filter.	**5**
4.2	**Centrifugation:** Objectives, principle & applications of Centrifugation, types of centrifuges, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, non-perforated basket centrifuge, semi continuous centrifuge, horizontal continuous centrifuge, super centrifuge	**3**
5	**Unit 5**	**7**
5.1	**Materials of pharmaceutical plant construction:** Factors affecting materials selection for pharmaceutical plant construction.	**2**
5.2	**Corrosion** **and its prevention:** Theories of corrosion, types of corrosion and their prevention. Ferrous and nonferrous metals, inorganic and organic non-metals, Basic of material handling system	**5**
	Total hours	**45**

Recommended Books (Latest Editions)

1. Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson-Latest edition.

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

Recommended weblinks: Youtube links for equipment working

1. Size Reduction
    a. https://www.youtube.com/watch?v=HgyXgQkxMTo
    b. https://www.youtube.com/watch?v=DkPpsZcnMhk
    c. https://www.youtube.com/watch?v=DPggUMaktjk
    d. https://www.youtube.com/watch?v=8skvUwgjB3Y
    e. https://www.youtube.com/watch?v=hfmg3nqdcjw
2. Size Separation
    a. https://www.youtube.com/watch?v=AM-NrQoRIYY
    b. https://www.youtube.com/watch?app=desktop&v=0dgvuFvWX20
    c. https://www.youtube.com/watch?v=vgyWfQWWx70
    d. https://www.youtube.com/watch?v=9KjhFnlfSsU
2. Drying
    a. https://www.youtube.com/watch?v=kQ7lBUC_QXg
    b. https://www.youtube.com/watch?app=desktop&v=1zDfEadU94Y
    c. https://www.youtube.com/watch?v=h8q5VHg53Q4
    d. https://www.youtube.com/watch?v=_jmJ3i7g9TQ
3. Filtration
    a. https://www.youtube.com/watch?app=desktop&v=EfTcfQY4kEY
    b. https://www.youtube.com/watch?app=desktop&v=7EV1KTqNkgo
    c. https://www.youtube.com/watch?app=desktop&v=cXk_gIOFvYU
4. Centrifugation
    a. https://www.youtube.com/watch?v=tdfky_oTXJA
    b. https://www.youtube.com/watch?v=l1fUOPpAtSg
5. Mixing
    a. https://www.youtube.com/watch?v=tU4vILQkQag
    b. https://www.youtube.com/watch?v=jFANj1FvjPs
    c. https://www.youtube.com/watch?v=-CfYXV_TcyM
    d. https://www.youtube.com/watch?v=cep81yJlgDk
    e. https://www.youtube.com/watch?v=DBaunvXm-Mk

Course code	Course Name	Credits
BP305P	**Pharmaceutical Organic Chemistry II - Practical**	**2**

- **Pre-requisites**
  - Safety rules & precautionary measures in the laboratory.
  - Some basic knowledge on conventional methods of synthesis of organic compounds

- **Course Outcomes: After the completion of the course, the learner will be able to:**
  1. Perform experiments involving laboratory techniques like recrystallization, and distillation.
  2. Determine analytical constants like Acid value and iodine value for Fats and Oils.
  3. Describe the theoretical aspects of organic synthesis & perform various unit operations of organic synthetic reactions.
  4. Plan, execute, and conclude the experiment using various methodologies (defined protocol or qualitative or quantitative techniques).

Sr. No.	Content
1	Recrystallization
2	Steam distillation
3	Determination of the following oil values (including standardization of reagents)
4	Organic Synthesis of Phenyl benzoate by acylation reaction.
5	Organic Synthesis Para bromo acetanilide from Aniline
6	Organic Synthesis of Meta di nitro benzene from Nitro benzene by nitration reaction.
7	Organic Synthesis of Benzoic acid from Benzyl chloride by oxidation reaction.
8	Organic Synthesis of Benzoic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.
9	1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions.
10	Benzil from Benzoin by oxidation reaction.
11	Dibenzal acetone from Benzaldehyde by Claison Schmidt reaction
12	Cinnamic acid from Benzaldehyde by Perkin reaction
13	P-Iodo benzoic acid from P-amino benzoic acid
14	Synthesis of acetanilide

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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. Practical Organic Chemistry by Mann and Saunders.
5. Vogel's textbook of Practical Organic Chemistry

Course code	Course Name	Credits
BP306P	**Physical Pharmaceutics I - Practical**	**2**

- **Pre-requisites**
  - Basic knowledge about the drug and different types of dosage forms

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand the principles and methods for the determination of various physical parameters of drugs and formulations.
  2. Carry out various physical tests involved in the characterization of drugs.
  3. Demonstrate testing of various physical parameters involved in preformulation and formulation evaluation.
  4. Plan, execute the experiment using various methodologies (defined protocol or qualitative or quantitative techniques) and summarize the findings in systematic way verbally and in written communication.

Sr. No.	Content
1.	Determination the solubility of drug at room temperature
2	Calibration of pH meter
3.	Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
4.	Determination of Partition coefficient of benzoic acid in benzene and water
5.	Determination of Partition coefficient of Iodine in CCl4 and water
6.	Determination of % composition of NaCl in a solution using phenol-water system by CST method
7.	Determination of surface tension of given liquids by drop count and drop weight method
8.	Determination of HLB number of a surfactant by saponification method
9.	Determination of Freundlich and Langmuir constants using activated charcoal and other excipients
10.	Determination of critical micellar concentration of surfactants
11.	Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
12.	Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method
13.	Determination of optical rotation of the given sample using polarimeter

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, Volume-1 to 3, MarcelDekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical pharmaceutics by Ramasamy C and ManavalanR.
8. Laboratory manual of physical pharmaceutics, C.V.S. Subramanyam, J. Thimma settee

Course code	Course Name	Credits
BP307P	**Pharmaceutical Microbiology – Practical**	**2**

- **Pre-requisites**
  - Basic knowledge of biochemistry and Biology

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Demonstrate methods of subculturing, characterization and identification of bacteria using various techniques (morphological, serological and
  2. biochemical)
  3. Practice methods of sterilization for various products, perform test for sterility on pharmaceuticals and bioassay of antibiotics.
  4. Apply the use of different equipments used in experimental.
  5. microbiology
  6. Plan, execute and conclude the experiment using various methodologies.

Sr. No.	Contents
Unit 1:	**Learning And Handling of instruments in Microbiology lab**
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.
Unit 2:	**Techniques of identification and classification of bacteria**
3	Staining methods- Simple, Negative Staining, Gram's staining and acid-fast staining (Demonstration with practical).
4	Motility determination by Hanging drop method.
5	Biochemical test (IMViC Reactions)
Unit 3:	**Cultivation and Isolation techniques of bacteria**
6	Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.
7	Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.
Unit 4:	**Applications in Pharmaceutical Industry**
8	Microbiological assay of antibiotics by cup plate method and other methods
9	Sterility testing of pharmaceuticals.
10	Thermal Death Point
11	Bacteriological analysis of water
Unit 5:	**Learning Advance Instruments: Demonstration**
12	Minimum Inhibitory Concentration (MIC) estimation of a given antimicrobial agent using Tube dilution method. Intro to MBC, MFC

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

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Course code	Course Name	Credits
BP308P	**Pharmaceutical Engineering – Practical**	**2**

- **Pre-requisites**
  - Basics understanding of unit processes covered under the subject of pharmaceutical engineering.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand mechanics of fluid, fluid flow, and its measurements
  2. Classify and describe heat measuring devices, mixers and dryers with respect to their applications in pharmacy.
  3. Understand basic principles involved in unit operations such as crystallization, evaporation, distillation, size reduction, filtration, centrifugation and refrigeration and will be able to describe the equipment and accessories involved therein.
  4. Summarize construction material, discuss corrosion of equipment from pharmaceutical industry point.

Sr. No.	Content
1	Determination of radiation constant of brass, iron, unpainted and painted glass
2	Steam distillation – To calculate the efficiency of steam
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 andlogarithmic 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 othermajor 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 a given sample by using Double Cone Blender.
14	To perform size reduction using Co-mill

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Recommended Books (Latest Editions)

1. Introduction to chemical engineering – Walter L Badger & Julius Banchero.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson.
3. Unit operation of chemical engineering – Mcabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al.
5. Remington practice of pharmacy- Martin.
6. Theory and practice of industrial pharmacy by Lachmann.
7. Physical pharmaceutics- C.V.S Subrahmanyam et al.

Recommended weblinks: Demonstration of equipment

1. https://www.youtube.com/watch?v=vz4audqdx5o
2. https://www.youtube.com/watch?v=_jmJ3i7g9TQ
3. https://www.youtube.com/watch?v=iWgRm5LSJek
4. https://www.youtube.com/watch?v=CqPtPvnF7co
5. https://www.youtube.com/watch?v=aqwfXS5_LAk
6. https://www.youtube.com/watch?v=snLEMu1NAdM
7. https://www.youtube.com/watch?v=EgW61Xfn7zY
8. https://www.youtube.com/watch?v=s68QueiRs9Y

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Course code	Course Name	Credits
IKS_BP_301	Yoga: A key to healthy life	-

- **Prerequisites**
  - Basic knowledge of Yoga and human health
- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Improvement in mental and physical health
  2. Provide improved attention in studies and better interpersonal relationships

Sr. No.	Content	Hours
1	**UNIT 1: INTRODUCTION**	10
1.1	Yoga-Meaning and definition, yoga misconceptions and comparison between yoga and exercise, Introduction to Ashtanga yoga (eight limbs of yoga), Pranav sadhana, Mudra and Bandh	06
1.2	Yoga therapy	02
1.3	Yoga and diet	02
2	**UNIT 2: AASANA (Introduction, contraindications, benefits and demonstration of following asanas**	12
2.1	**Sitting postures**: Swastikasana, padmasana, Marjarasana, Bhadrasana, Vajrasana, Ustrasana, Sasakasana, Vakrasana, Paschimatanasana, Parvatasana	03
2.2	**Standing postures**: Tadasana, Vrksasana, Pada-hastasana, Ardha chakrasana, Trikonasana	03
2.3	**SUPINE POSTURES**: Setubandhasana, Uttana padasana, Ardha halasana, Pavana muktasana, Savasana, Viparit karni, tadagi mudra	03
2.4	**Prone postures**: Makarasana, Bhujangasana, Salabhasana, Naukasana, Matsyasana	02
2.5	Suryanamaskar	01
3	**UNIT 3: PRANAYAMA (Introduction, contraindications, benefits and demonstration of following pranayama)**	02
3.1	Kapalabhati, Anulom vilom, Sitali, Sitakari, Bhramari, Ujiayi, Bhastrika, Uddiyana bandha	02
4	**UNIT 4: STRESS MANAGEMENT**	06
4.1	Meditation, Yog nidra, Shavasana, Mindfulness, Prayers	04
4.2	Yogic lifestyle	02
	Total Hours	30

Recommended Book (Latest Editions): Know yoga Live Yoga, By ShriKrishna Mhaskar

Recommended Website: https://ayush.gov.in/

Semester IV

Course code	Course Name	Credits
BP401T	**Pharmaceutical Organic Chemistry III - Theory**	**4**

- **Pre-requisites**
  - Basic structure, synthesis, stereochemistry, and medicinal uses of the compounds

- **Course Outcomes: After the completion of the course, the learner will be able to:**
  1. Understand basic concepts and various terminologies involved in stereochemistry.
  2. Recognize the methods of preparation and properties of heterocyclic organic compounds.
  3. Predict and explain the reaction products considering the mechanisms and their stereochemical aspects.

Sr. No.	Content	Hours
1	**Unit 1: Stereo isomerism**	**10**
1.1	**Optical isomerism** – Optical activity, enantiomerism, diastereo-isomerism, 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 Introduction to chirality around sulfur and phosphorus	**10**
2	**Unit 2: Geometrical isomerism**	**10**
2.1	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	**10**
3	**Unit 3: Heterocycles**	**10**
3.1	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	**10**
4	**Unit 4: Heterocycles**	**10**
4.1	Synthesis, reactions and medicinal uses of the 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	**10**
5	**Unit 5: Reactions of Synthetic Importance**	**05**
5.1	Metal hydride reduction ($NaBH_4$ and $LiAlH_4$), Clemmensen reduction, Birch reduction, Wolff Kishner reduction.	**02**
5.2	Oppenauer-oxidation and Dakin reaction. Beckmann and Schmidt	**03**

	rearrangement, Claisen Schmidt condensation, Knoevenagel reaction	
	Total hours	**45**

Recommended Books (Latest Editions)

1. Organic chemistry by I.L. Finar, Volume-I & II.
2. Stereochemistry, Organic Chemistry by Nick Greeves, Jonathan Clayden, Stuart Warren, Second edition.
3. McMurry 8th edition pp
4. Organic Reaction mechanisms by V. K. Ahluwalia and Rakesh Kumar, 4th edition, Pub. Alpha Science, Oxford, U.K.
5. Heterocyclic Chemistry by Raj K. Bansal
6. Organic Chemistry by Morrison and Boyd
7. Heterocyclic Chemistry by T.L. Gilchrist

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Course code	Course Name	Credits
BP402T	**Medicinal Chemistry I – Theory**	**4**

- **Pre-requisite**
  - Concepts learned in General Chemistry Organic chemistry, biochemistry, Physical Chemistry (Pharmacy), anatomy & physiology and microbiology.

- **Course Outcomes: After the completion of the course, the learner will be able to:**
  1. Identify and study the suitable drug targets for the treatment of disorders.
  2. Identify the relationship between the physicochemical properties of the chemical entity and the biological response.
  3. Draw a schematic metabolic pathway for any given drug.
  4. Identify the SAR of all the classes of Drugs acting on the Autonomic Nervous System, Cholinergic neurotransmitters, and Drugs acting on the Central Nervous System.

Note: 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*		
Sr. No.	**Content**	**Hours**
1	**Unit 1: Introduction to Medicinal Chemistry & Drug Targets**	**10**
1.1	• 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	**10**
1.2	• Structure of Receptors as Drug Target: Types of Receptors and signal transduction - Ion Channels, G-Protein Coupled Receptor (GPCR), Kinases, Nuclear Receptors • Structural and interaction patterns of Agonist, Antagonist, Partial agonist, Inverse agonist	
1.3	• Drug metabolism Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereochemical aspects	
2	**Unit 2: Drugs acting on Autonomic Nervous System**	**08**
2.1	• **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	**08**

	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.	
3	**Unit 3: Cholinergic neurotransmitters**	**08**
3.1	• **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 hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.	**08**
4	**Unit 4:Drugs acting on Central Nervous System**	**12**
4.1	• **Sedatives and Hypnotics:** **Benzodiazepines:** SAR of Benzodiazepines, Mode of action (in brief), Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem **Barbiturtes:** Classification based on DoA, SAR of barbiturates, Mode of action (in brief), Barbital*, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital **Miscellaneous:** Amides and imides: Glutethimide. Alcohol & their carbamate derivatives: Meprobamate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.	**04**

4.2	• **Antipsychotics** **Phenothiazeines:** SAR of Phenothiazeines, Mode of action (in brief), Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride. **Ring Analogues of Phenothiazines**: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine. **Fluro butyrophenones**: Haloperidol, Droperidol, Risperidone. **Beta amino ketones**: Molindone hydrochloride. **Benzamides:** Sulpieride.	**04**
4.3	• **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	**04**
5	**Unit 5:Drugs acting on Central Nervous System**	**07**
5.1	• **General anesthetics** • **Stages of anesthesia (Self-study)** **Inhalation anesthetics:** Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane. **Ultra short acting barbitutrates**: Methohexital sodium*, Thiamylal sodium, Thiopental sodium. **Dissociative anesthetics**: Ketamine hydrochloride.* (Only structures and classification based on type of agents and duration of action)	**01**
5.2	• **Narcotic and non-narcotic analgesics** **Morphine and related drugs**: SAR of Morphine analogues Mode of action of opioids (in brief), different types of opioid receptors Classification: 4,5-Epoxymorphinans, morphinans, benzomorphans, 4-phenylpiperidines and 4-anilidopiperidines, diphenylheptanes. Stereochemistry of Morphine 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	**04**

5.3	• **Anti-inflammatory agents:** Mode of action (in brief) and NSAID-induced side effects Chemical classification of NSAIDs Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone, Selective COX-2 inhibitors (MOA and few drugs in brief)	**02**
	Total Hours	**45**

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. Textbook of practical organic chemistry- A.I.Vogel

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Course code	Course Name	Credits
BP403T	**Physical Pharmaceutics II – Theory**	**4**

- **Pre-requisites**
  - Basic understanding of the various physical phenomena involved in designing various formulations.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand the concept of coarse and colloidal dispersions, rheology, powder technology and drug stability
  2. Identify the different types of dispersion, rheological properties of the different dosage form.
  3. Identify different order of reactions and pathways of drug degradation.
  4. Apply basic principles of drug characterization to achieve stable and reproducible drug delivery.

Sr. No.	Content	Hours
1	**Unit 1: Colloidal dispersions**	**07**
1.1	Classification of dispersed systems & their general characteristics: size & shapes of colloidal particles	**01**
1.2	Methods of preparation of colloids, Classification of colloidal dispersions & comparative account of their general properties: Optical, kinetic & electrical properties.	**03**
1.3	Instability of colloidal dispersions: Effect of electrolytes	**01**
1.4	Stability of colloids: Protective action of colloids; Coacervation, Peptization	**02**
2	**Unit 2: Rheology & Deformation of solids**	**10**
2.1	Concept of viscosity, law of flow, kinematic viscosity, types of viscosity, effect of temperature, Factors affecting viscosity, Newtonian systems	**02**
2.2	Non- Newtonian systems: pseudoplastic, dilatants, plastic	**02**
2.3	Thixotropy, deviations, measurement, thixotropy in formulation, Negative thixotropy	**01**
2.4	Determination of viscosity: Single point-capillary, falling sphere, Multipoint- cup and bob, rotational viscometers/cone and plate viscometer	**02**
2.5	Plastic and elastic deformation, Heckel plot, Stress, Strain, Elastic Modulus	**03**
3	**Unit 3: Coarse Dispersion**	**10**
3.1	Classification of suspension: flocculated and Deflocculated suspension	**01**
3.2	Interfacial properties of suspended particles	**01**

3.3	Settling in suspensions: Theory in sedimentation, Effect of Brownian movement, sedimentation of flocculated particles and sedimentation parameters like sedimentation volume and degree of flocculation, Formulation of suspensions: Wetting of particles, controlled flocculation, Flocculation in structured vehicle	**03**
3.4	Emulsions and theories of emulsification, Microemulsion and multiple emulsions	**03**
3.5	Physical stability of emulsions, Preservation of emulsions, Rheological properties of emulsions, Phase equilibria and emulsion formulation	**02**
4	**Unit 4: Micromeritics**	**10**
4.1	Introduction, Applications, Particle characteristics: Particle size and particle shape. Powder Characteristics: Arithmetic mean, Geometric mean, Harmonic mean. Particle number. Numericals. Particle size distribution, distribution curves—frequency, log normal, cumulative frequency, log probability	**04**
4.4	Particle size determination methods: counting-optical microscopy. Diameters-projected area, Martin and Feret and separation method-Sieving method, Sedimentation method, Conductivity method	**02**
4.5	Powder surface area: specific surface, methods for determining surface area- air permeability, adsorption.	**01**
4.6	Derived properties of powders: true density- methods to determine true volume from porous and non porous solids, granule density, bulk density. Porosity, Packing arrangement, Flow properties-angle of repose, dispersibility	**03**
5	**Unit 5: Drug stability**	**08**
5.1	Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants	**01**
5.2	Determination of reaction order	**01**
5.3	Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis	**02**
5.4	Simple numerical problems: zero order, first order and second order reaction, Arrhenius factor and energy of activation	**01**
5.5	Stabilization of medicinal agents against common reactions like hydrolysis & oxidation	**01**
5.6	Accelerated stability testing in expiration dating of pharmaceutical dosage forms, Photolytic degradation and its prevention	**02**
	Total Hours	**45**

Recommended Books (Latest Editions)

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

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Course Code	Course Name	Credits
BP404T	**Pharmacology I - Theory**	**4**

- **Prerequisites:**
  - Students should possess knowledge about the following:
    - Anatomy and physiology of the central and peripheral nervous systems
    - Pathophysiology of diseases associated with the central and peripheral nervous systems.
- **Course Outcomes: After completion of this course students should be able to:**
  1. Explain the basic pharmacological principles related to drugs like concepts of agonists, antagonists, and receptor pharmacology.
  2. Explain the basic principles of Pharmacokinetics, Pharmacodynamics, and adverse reactions of drugs.
  3. Explain the pharmacology and drugs used for the peripheral nervous system and central nervous system.
  4. Analyze and apply the knowledge of basic principles of pharmacology in predicting adverse drug reactions, drug interactions, and drug development process.

Sr. No.	Content	Hours
1	**Unit 1: General Pharmacology**	**08**
1.1	**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 (to be covered in Unit 5), Introduction to organ on chip, tachyphylaxis, idiosyncrasy, allergy	**04**
1.2	**Pharmacokinetics**- Membrane transport, absorption, distribution, metabolism and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination	**04**
2	**Unit 2: General Pharmacology**	**12**
2.1	Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. Drug receptor interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptors, transmembrane enzyme-linked receptors, transmembrane JAK-STAT binding receptors and receptors that regulate transcription factors, dose-response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.	**06**
2.2	Adverse drug reactions	**02**
2.3	Drug interactions (pharmacokinetic and pharmacodynamic),	**02**
2.4	Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance	**02**
3	**Unit 3: Pharmacology of peripheral nervous system**	**10**

3.1	Organization and function of ANS, Neurohumoral transmission, cotransmission and classification of neurotransmitters	**01**
3.2	• **Parasympathomimetics** – Acetylcholine, Pilocarpine, Anticholinesterase • **Parasympatholytic**s – Atropine • **Sympathomimetics-** Adrenaline, salbutamol, Amphetamine, Oxymethazooline • **Sympatholytics** – Phenoxybezamine, Prazosin, Yohimbine, Ergotamine, Propanolol, Atenolol, Labetelol	**03**
3.3	• **Neuromuscular blocking agents and skeletal muscle relaxants (peripheral)** - Dantroline, quinine, succinyl choline, Tubocurarine, Mivacurium	**02**
3.4	Local anesthetic agents	**03**
3.5	Drugs used in myasthenia gravis and glaucoma	**01**
4	**Unit 4: Pharmacology of central nervous system**	**08**
4.1	Neurohumoral transmission in the C.N.S. special emphasis on the importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.	**01**
4.2	• **General anesthetics** –Nitrous oxide, halothane, Thiopentone sodium, Diazepam, Fentanyl, Ketamine • **Pre-anesthetics**	**02**
4.3	• **Sedatives Hypnotics**– Diazepam, Phenobarbitone, Thiopentone, Pentobarbitone, Zopiclone, Flumazenil • **Centrally acting muscle relaxants** – Mephenesin congeners, Diazepam, Baclofen, Tizanidine	**02**
4.4	• **Anti-epileptics** – Phenobarbitone, Primidone, Phenytoin, Carbamazepine, Ethosuximide, Valproic acid, Diazepam, Lamotrigine, Gabapentin, Topiramate	**02**
4.5	Alcohols and disulfiram - Ethyl alcohol, Methyl Alcohol	**01**
5	**Unit 5: Pharmacology of central nervous system**	**07**
5.1	Psychopharmacological agents: • **Antipsychotics –** Chlorpromazine, Thioridazine, Trifluoperazine, Haloperidol, Flupenthixol, Pimozide, Clozapine, Olanzapine • **Antidepressants-**Moclobemide, Imipramine, Desipramine, Fluoxetine, Venlafaxine, Trazodone • **Antianxiety agents –** Diazepam, Buspirone, Hydroxyzine, Propranolol • **Anti-manics** – Lithium carbonate • **Hallucinogens** - Lysergic Acid Diethylamide (LSD), Cannabinoids, Phencyclidine, Phenylalkyl Amines	**02**
5.2	• **Drugs used in Parkinson's disease** - Levodopa (l-dopa), Carbidopa, Bromocriptine, Selegiline, Entacapone, Amantadine, Procyclidine, Promethazine (Contraindicated in PD, reseason shall be discussed).	**01**

	• **Drugs used in Alzheimer's disease:** Rivastigmine, Memantine, Piracetam, Pyritinol, Ginkgo biloba.	
5.3	• **CNS stimulants and nootropics – Strychnine**, Pentylenetetrazol (PTZ), Doxapram, Amphetamines, Caffeine	**01**
5.4	• **Opioid analgesics and antagonists** - Morphine, Diacetylmorphine, Pethidine, Methadone, Nalorphine, Buprenorphine, Naloxone	**02**
5.5	Drug addiction, drug abuse, tolerance and dependence.	**01**
	Total Hours	**45**

The syllabus encompasses prototype drugs representing their respective classes, as well as other drugs belonging to these classes, even if they are not explicitly mentioned.

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. K. D. Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
5. Satoskar and Bhandarkar, Pharmacology and Pharmacotherapeutics Pharmacology (Lippincott's Illustrated Reviews Pharmacology)

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Course code	Course Name	Credits
BP405T	**Pharmacognosy and Phytochemistry I– Theory**	**4**

- **Prerequisites**
  - Basic knowledge of biology, plant cell and tissues
- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Outline the Alternative and complementary systems of medicine, classify drugs of natural origin
  2. Describe primary and secondary plant metabolites their biosynthesis, evaluation and therapeutic application
  3. Describe the applications of plant tissue culture techniques with respect to production of secondary metabolites and edible vaccines
  4. Elaborate commercial production, collection, preparation, storage and factors affecting cultivation of medicinal plants and its conservation
  5. Evaluate and analyse crude drugs by morphological and microscopic and other evaluation techniques of Drugs of Natural Origin
  6. Describe the source, composition, preparation and applications of crude drugs containing carbohydrates, lipids, fibers, important protein and enzymes of natural origin and marine drugs

Sr. No.	Content	Hours
1	**UNIT 1**	**10**
1.1	**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).	**03**
1.2	**Classification of drugs:** Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs	**02**
1.3	**Quality control of Drugs of Natural Origin:** Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida.	**05**
2	**UNIT 2**	**12**
2.1	**Cultivation, Collection, Processing and storage of drugs of natural origin:** Cultivation and Collection of drugs of natural origin Factors influencing cultivation of medicinal plants. Plant hormones and their applications. • Polyploidy, mutation and hybridization with reference to medicinal plants	**10**
2.2	**Conservation of medicinal plants**	**02**
3	**UNIT 3**	**07**
3.1	**Plant tissue culture:** Historical development of plant tissue culture, types of cultures, Nutritional	**07**

	requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines Various types of Plant Tissue Culture: Callus Culture, Suspension Culture, Protoplast culture, Introduction to Transgenic plants	
4	**UNIT 4**	**10**
4.1	**Pharmacognosy in various systems of medicine:** • Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine	**03**
4.2	**Introduction to secondary metabolites:** Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins Difference between Primary metabolites and Secondary metabolites Alkaloids – Chemical classification. True, proto, pseudo. Common test Glycosides – Chemical and individual Chemical test General chemical tests for Tannins, Volatile Oil (Terpenes and Phenylpropanoids) And main chemical test and Resins (Ole, oleo gum, gum and balsam) Natural/ • prepared. Tests based on properties	**07**
5	**UNIT 5; Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs**	**08**
5.1	a. **Plant Products:** Fibers - *Cotton, Jute, Hemp,* Hallucinogens, Teratogens, Natural allergens b. **Primary metabolites:** General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites: c. **Carbohydrates:** *Acacia, Agar, Tragacanth, Honey* d. **Proteins and Enzymes :** *Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin).* *e.* **Lipids (Waxes, fats, fixed oils)**: *Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax* f. **Marine Drugs:** Novel medicinal agents from marine sources	
	TOTAL	**45**

Recommended Books (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.

5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. Iyengar
10. Pharmacognosy and Phytochemistry by Dr Biren Shah
11. Pharmacognosy and Phytochemistry by Dr Vinod Rangari Volume I & Volume II

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Course code	Course Name	Credits
BP406P	**Medicinal Chemistry I - Practical**	**2**

- **Pre-requisites**
  - Handling different sets of laboratory apparatus required for synthesis and analysis Basics of safety aspects while working in the chemistry lab.

- **Course Outcomes: After the completion of the course, the learner will be able to:**
  1. Demonstrate skills in handling synthetic procedures and quantitative evaluation techniques.
  2. Understand and apply various isolation techniques, purification techniques in synthetic chemistry, and different types of assay methods for quantitative evaluation.
  3. Design or predict experimental requirements for determining the partition coefficient of organic molecules and interpreting results obtained.
  4. Recognize the reaction from experimental conditions, deduce the mechanism and transform one functional group to other.
  5. Demonstrate oral & written communication skills & ability to plan the experimentation with proper time management.

Sr. No.	Content
Unit 1	**Synthesis of the following drugs**
1.	1,3-pyrazole
2.	1,3-oxazole
3	Benzimidazole
4	Benzotriazole
5	2,3- diphenyl quinoxaline
6	Benzocaine
7	Phenytoin
8	Phenothiazine
9	Barbiturate
Unit 2	**Assay of drugs**
1	Chlorpromazine / Can be replaced with Caffeine
2	Phenobarbitone/ Can be replaced with Phenytoin
3	Atropine by UV spectrophotometric method
4	Ibuprofen
5	Aspirin
6	Furosemide by UV spectrophotometric method

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.
5. Martindale's extra pharmacopeia.
6. Organic Chemistry by I.L. Finar, Vol. II.
7. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
8. Indian Pharmacopoeia.
9. Textbook of practical organic chemistry- A. I. Vogel.

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Course code	Course Name	Credits
BP407P	**Physical Pharmaceutics II – Practical**	**2**

- **Pre-requisites**
  - Basic knowledge of physical chemistry of drug, powder and liquid dosage forms

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Demonstrate the properties of the powder and liquid dosage forms and comment on the quality.
  2. Determine reaction rate constant, order of a reaction for different reactions
  3. Predict shelf life by carrying out accelerated stability studies
  4. Demonstrate testing of various physical parameters involved in preformulation and formulation evaluation.
  5. Plan, execute the experiment using various methodologies (defined protocol or qualitative or quantitative techniques) and summarize the findings in systematic way verbally and in written communication.

Sr. No.	Contents
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
12	Determination of concentration range of Aluminium Chloride as a deflocculating agent in Kaolin suspension

Recommended Books (Latest Editions)

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

Course Code	Course Name	Credits
BP408P	**Pharmacology I - Practical**	**2**

- **Prerequisites:**
  - Students should possess knowledge about the following:
    - General Pharmacology including principles of agonist, antagonists and receptor pharmacology
    - Basic concepts related to drugs acting on central and peripheral nervous system

- **Course Outcomes: After completion of this course students should be able to:**
  1. Demonstrate proficiency in the principles and methodologies of experimental pharmacology, including the ethical handling and care of laboratory animals as per regulatory guidelines.
  2. Apply critical thinking skills to design, conduct, and interpret experiments evaluating the efficacy and mechanisms of action of pharmacological agents on various physiological systems, such as the central nervous system and gastrointestinal tract.
  3. Analyze and interpret experimental data collected from pharmacological studies, including the effects of drugs on behavior, motor function, and physiological responses, to draw meaningful conclusions and infer potential clinical implications.
  4. Evaluate drug interactions through prescription analysis.
  5. Plan, execute and conclude the experiment using various methodologies and communicate scientific findings effectively in writing and presentations.

Content	
Unit 1:	**General Concepts of Experimental Pharmacology and animal handling**
• Introduction to experimental pharmacology. • Commonly used instruments in experimental pharmacology. • Study of common laboratory animals. • Maintenance of laboratory animals as per CPCSEA guidelines. • Study of different routes of drugs administration in mice/rats.	
Unit 2:	**Study of the efficacy of drugs acting on central nervous system**
• Effects of skeletal muscle relaxants using rota-rod apparatus. • Effect of drugs on locomotor activity using actophotometer. • Anticonvulsant effect of drugs by MES and PTZ method. • Study of stereotype and anti-catatonic activity of drugs on rats/mice. • Study of anxiolytic activity of drugs using rats/mice.	
Unit 3:	**Study of the efficacy of drugs acting on gastrointestinal tract and locally acting drugs**
• Effect of drugs on ciliary motility of frog oesophagus • Effect of drugs on rabbit eye. • Study of local anesthetics by different methods • To study DRC of Acetyl Choline using hen/cock ileum • Study of effect of agonist and antagonist on DRC of Ach	

Unit 4:	Prescription analysis
• Analysis of Prescription and product labels for determining Drug Interactions	

Recommended Books (Latest Editions)

1. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata
2. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan
3. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier
4. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
5. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
6. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology
7. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.

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Course code	Course Name	Credits
BP409P	**Pharmacognosy and Phytochemistry I -Practical**	**2**

- **Prerequisites**
  - Basic knowledge of biology, plant parts, cell and tissues
- **Course Outcomes**
  1. Carry out quantitative microscopy for leaf constants
  2. Determine different extractive values, ash values, moisture content, swelling index and foaming index as per Official Compendia
  3. Determine the histological features of plants of diagnostic significance such as calcium oxalate crystals, starch grains, length and width of fibres
  4. Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management
  5. Identify crude drugs containing carbohydrates, lipids and protein by chemical tests.

Exp. No.	Title of the Experiment
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 stomatal index
3.	Determination of vein islet number, vein islet termination and palisade ratio.
4.	Determination of size of starch grains, calcium oxalate crystals by eye piece micrometre
5.	Determination of Fiber length and width
6.	Determination of number of starch grains by Lycopodium spore method
7.	Determination of Ash value
8.	Determination of Extractive values of crude drugs
9.	Determination of moisture content of crude drugs
10.	Determination of swelling index and foaming

Recommended Books (Latest Editions)

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

Course code	Course Name	Credits
VEC_BP_401	Universal Human Values	-

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. To develop understanding of the concepts of Universal Human Values
  2. To recognize the relevance of Universal Human Values
  3. To develop understanding of value systems that are shared by our culture.
  4. To critically analyze current issues related to values
  5. To develop a sense of personal self in harmony with society and nature through integration of Universal Human Values
  6. To explore ways to integrate human values in personal and professional life.

Sr. No.	Content	Hours.
1	**Exploring the Self**	**08**
1.1	Concept of Universal Human Values: • Characteristics of Universal Human Values • Difference between value-based education and skill based education • Content of value education	**03**
1.2	Self-Exploration and Basic Aspirations of Human beings: • Self-Exploration– Meaning and Process • Basic Human Aspirations – Meaning and Basic Requirements for fulfilling. • Measures to fulfil basic human aspirations in the current scenario.	**03**
1.3	Tutorials and Practicum Activities: • Students practice mindfulness techniques like body scan, mindful breathing, and guided mindfulness meditation etc for strengthening self-awareness. • Students reflect on the process of Natural acceptance and its • experiential validation in their day-to-day life activities • Students maintain a reflective account of the times they felt happy and prosperous and the causes of that happiness and prosperity for them. • Students reflect on the process of Natural acceptance and its experiential validation in their day-to-day life activities, hospital visits, visits to community pharmacy	**02**
2	**Understanding Harmony – Self and Family**	**07**
2.1	Harmony with Self: • Concept of Human Existence – Conscious and Material Entities • Difference between the Conscious and the Material Entities of Human Existence • iii. Measures to ensure Harmony in the Self	**02**
2.2	Harmony with Family: • Relationship as the basis of harmony in the family	**03**

	• Exploring value of feelings in relationships • iii. Measures to ensure Harmony in the family	
2.3	Tutorials and Practicum Activities: • Students maintain a log of the time and money spent in satisfying the needs of the Self and the needs of the body. • Review and discussion of scenes from movies/books to critically analyse the feelings underlying the relationships issues and ways to resolve. • Students chalk out an action plan for working on their relationship issues through using communication skills and managing feelings. • Students enlist the plan of work while working in the group activities like DLLE, NSS, NCC, Public Health Office, laboratories, project work. Students may be introduced with Buddy Concept where senior student will be appointed as mentor with junior students on particular assigned work. Understand Students perspective towards team building	**02**
3	**Understanding harmony in Society and Professional Ethics**	**08**
3.1	Harmony with Society: • Understanding conflict (meaning, types) • Dimensions of Human order for harmony in society • Universal value of justice, democracy, respect and gratitude	**03**
3.2	Professional Ethics in the Context of maintaining harmony: • Need for a code ethics (philosophy references for ethics) • Integrating Inclusiveness • iii. Relevance and competence in professional ethics	**03**
3.3	Tutorials and Practicum Activity • Students choose a conflict that they observe in society and have a group discussion for possible ways to resolve the conflict. • Students engage in an interaction an expert on laws that protect. (Abortion, Euthanasia, Juvenile Justice and Sexual harassment). Students write a reflective account on how they practice inclusion in their day-to-day life and ways to do it in their future professional careers. • Students write a reflective report at various activities at college level, industry visits, camps etc.	**02**
4	**Understanding harmony in Nature**	**07**
4.1	Concept of harmony in Nature: • Meaning of harmony in nature • Disharmony with Nature – causes • Implications of disharmony with nature	**02**
4.2	Maintaining harmony with nature: • Harmony through mutual fulfilment of the four orders in nature	**03**

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	• Harmony through symbiotic relationship with nature • Achieving competence in maintaining harmony with nature in professional life.	
4.3	Tutorials and Practicum Activities • Students can write an account of different ways of integrating three Rs (Reduce, Reuse and Recycle) in their day-to-day life • Students review of books/movies dealing with harmony with nature. • Activities like Poster competition/slogan competition/street play/activities using social media on the theme of maintaining harmony with nature may be organized. • Students can work on apps, slogans to Protect Nature, methods to reduce industrial waste, application of green chemistry as per the needs of the pharmaceutical industry • Suggest Plan to reduce Hospital waste/ Pharmaceutical Industrial waste/ Reduce Plastic waste/ E Waste Management • Students can work on the Project of Energy Conservation	**02**
5	**Holistic Perspective of Harmony at all levels of Existence and current issues due to disharmony Harmony with Self**	**08**
5.1	Existence at all levels: • Existence as Units in space • Existence as coexistence • iii. Application of harmony through coexistence through integration of Universal Human Values	**03**
5.2	Holistic perception of harmony in existence: • Development of harmony in the existential sense • Current issues leading to disharmony at all levels • iii. Application of Universal Human Values for resolution of current issues.	**03**
5.3	Tutorials and Practicum Activities: • Students gather information about CSR activities carried out by various organizations • Students write a reflective account of how they can be socially relevant as in their professions. • Students may participate in a two-day residential camp and engage in community service activities. iv. Students can gather information on the CSR activities planned by Pharmaceutical industries, evaluate its social outcome	**02**
6	**Practicum Project– Community Engagement**	**07**
6.1	Students carry out a community engagement project to benefit the local community through initiatives which can be undertaken face to face or online. They write a reflective report of how the understanding of universal human values has been integrated in their work during the community	**07**

	engagement. *Students can work on Community Pharmacy Projects such as Training to Senior citizens, Health awareness programmes such as Diabetes Camp, Blood Donation Camp, TB awareness program, Health for all, Mental Health for all age groups etc.*	
	Total Hours	**45**

Recommended Books (Latest Editions)

1. Dr R. R. Gaur, Sh. Rajul Asthana, Sh G.P. Bagaria, A textbook of Human Values and Professional Ethics, Excel books, New Delhi.
2. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2.
3. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi, 2010.
4. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
5. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.
6. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991.
7. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA.
8. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
9. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
10. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
11. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
12. A.N. Tripathy, 2003, Human Values, New Age International Publishers.
13. A.P.J. Abdul Kalam. Wings of Fire, Universities Press,2003.
14. Bandhu, Pranjali (ed.) Back to Basics: A J C Kumarappa Reader, (Introduction by T G Jacob). Ootacamund: Odyssey,2011.
15. Eger Edith. The Gift-12 Lessons to Save Your Life. ISBN: 9781846046278.
16. Eger Edith. The Choice- Even in hell hope can flower. ISBN: 9781846045127.
17. Frankl Viktor E. Man's Search for Meaning, Viktor E. Frankl, Rider, Ebury Publishing, 2004.
18. Frankl, Viktor E. Yes to Life In spite of Everything, Penguin Random House, London, 2019.
19. Gandhi, M K, 1909. Hind Swaraj or Indian Home Rule. Ahmedabad: Navajivan Publishing House, 1996.
20. Gandhi, M.K. My Experiments with Truth- An Autobiography, India Book Distributors, ISBN: 978-9387585-20-1, 2017.
21. Maulana Abdul Kalam Azad. India Wins Freedom-Reproduced by Sani H. Panhwar (2017).

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22. R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics Excel Books, New Delhi, 2010.
23. Schumacher E.F. Small is Beautiful A Study of Economics As If People Mattered. Harper Collins, 2010.
24. Tolstoy, Leo. The Kingdom of God is Within You, ISBN: 1-4209-2487-7, Stilwell, 2005.
25. Yogananda Paramhansa. Autobiography of a Yogi, The Philosophical Library, 1946.
26. Ranganathananda, Swami. Eternal values for a changing society. Advaita Ashrama, Calcutta. (Four volumes) Swami Srikantananda (compiled)Youth, Arise, Awake (Set of six books), Advaita Ashrama, Kolkata. Values: The Key to a meaningful life. (Compilation). Sri Ramakrishna Math, Chennai.
27. Cofield, J., Plass, R. (2014). The Relational Soul: Moving from False Self to Deep Connection. United Kingdom: InterVarsity Press.
28. Dunn, R. (2016). Values and the Reflective Point of View: On Expressivism, Self-Knowledge and Agency. United Kingdom: Taylor & Francis.
29. Gaur, R. R., Sangal, R., & Bagaria, G. P. (2010). A Foundation Course in Human Values and Professionals Ethics. New Delhi: Excel Books India.
30. Gergen, K. J. (2009). Relational Being: Beyond Self and Community. United Kingdom: Oxford University Press.
31. Le Messurier, M. (2020). Teaching Values of Being Human: A Curriculum that Links Education, the Mind and the Heart. United Kingdom: Taylor & Francis.
32. Maio, G. R. (2016). The Psychology of Human Values. United Kingdom: Taylor & Francis.
33. Tripathi, A. N. (2009). Human Values. New Delhi: New Age International Pvt. Limited.
34. Van Zomeren, M., & Dovidio, J. F. (2018). The Oxford Handbook of the Human Essence (Eds.). New York: Oxford University Press.

Recommended Articles

1. Fitzgerald, P. (1998). Gratitude and justice. Ethics, 109(1), 119-153.
2. Jordan, K., & Kristjánsson, K. (2017). Sustainability, virtue ethics, and the virtue of harmony with nature. Environmental Education Research, 23(9), 1205-1229.
3. Kagitcibasi, C. (2005). Autonomy and relatedness in cultural context: Implications for self and family. Journal of cross-cultural psychology, 36(4), 403-422.
4. Ryan, R. M., & Deci, E. L. (2000). The darker and brighter sides of human existence: Basic psychological needs as a unifying concept. Psychological inquiry, 11(4), 319-338.
5. Schwartz, S. H. (1994). Are there universal aspects in the structure and contents of human values? Journal of social issues, 50(4), 19-45.
6. Schwartz, S. H., & Bilsky, W. (1987). Toward a universal psychological structure of human values. Journal of personality and social psychology, 53(3), 550.

Recommended Weblinks

1. Story of Stuff, http://www.storyofstuff.com
2. Al Gore, An Inconvenient Truth, Paramount Classics, USA
3. Charlie Chaplin, Modern Times, United Artists, USA
4. IIT Delhi, Modern Technology – the Untold Story
5. Gandhi A., Right Here Right Now, Cyclewala Productions

6. Vivekananda - Romain Rolland (English) Romain Rolland - Swami Vivekananda
7. https://www.swamivivekananda.guru/2017/05/07/romain-rolland
8. website accessed on Monday, 5 April, 2021 at 4:15 PM.
9. https://yourmorals.org/schwartz.2006.basic%20human%20values.pdf

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Semester V

Course code	Course Name	Credits
BP501T	**Medicinal Chemistry II – Theory**	**4**

- **Pre-requisites**
  - Familiarity with biological systems and physiological processes relevant to pharmacology.
  - Proficiency in interpreting chemical structures and understanding stereochemistry.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand the chemistry of drugs concerning their pharmacological activity.
  2. Classify drugs based on its structure/ mechanism of action/ site of action.
  3. Understand the drug metabolic pathways, adverse effects, and therapeutic value of drugs.
  4. Know the Structural Activity Relationship of different classes of drugs.
  5. Study the chemical synthesis of selected drugs.

Note: 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 (*)		
Sr. No.	**Content**	**Hours**
1	**Unit 1**	**16**
1.1	**Combinatorial Chemistry:** Concept and applications of Combinatorial chemistry: solid phase and solution phase synthesis.	**02**
1.2	**Prodrugs:** Basic concepts and application of prodrugs design.	**03**
1.3	**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, Tafts steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques	**06**
1.4	**Antihistaminic agents:** Histamine, receptors and their distribution in the human body **Inhibitors of histamine release:** Cromolyn sodium **H_1–antagonists:** General SAR of classical H1 antihistaminics Structural classification of classical H1 antihistaminics Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamine succinate, Clemastine fumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartrate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate,	**04**

	Second generation H1–antagonists: Astemizole, Loratadine, Cetirizine, Levocetirizine, fexofenadine, acrivastine, ebastine and bepotastine combination of H1 antihistamines and monteleukast (LT antagonist) **H_2-antagonists:** Rational development of Cimetidine*, Famotidine, Ranitidine, nizatidine, lafutidine	
1.5	**Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole. Mechanism of action of Proton Pump inhibitors	**01**
2	**Unit 2**	**12**
2.1	**Anti-anginal**: **Vasodilators:** Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbidedinitrite*, Dipyridamole. **Calcium channel blockers: classification of entire and SAR of only "dipine" class:** Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine. **Drugs used in Congestive Heart Failure:** Digoxin Digitoxin, Nesiritide, Bosentan, Tezosentan. (self-study)	**03**
2.2	**Anti-hypertensive Agents**: Rational Development of Captopril (Drug receptor interaction), Lisinopril, Enalapril, Fosinopril (SAR of ACE inhibitors), Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride*, Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.Timolol Angiotensin II receptor blockers- losartan, valsartan, telmisartan, olmesartan.	**05**
2.3	Diuretics: Classification based on site of action 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	**04**
3	**Unit 3**	**04**
3.1	**Anti-arrhythmic Drugs**: Mechanistic classification: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol.	**02**
3.2	**Anti-hyperlipidemic agents**: Clofibrate, HMG-CoA reductase inhibitors: lovastatin, atorvastatin, simvastatin, rosuvastatin, Cholesteramine, and Cholestipol	**02**
3.3	**Coagulant & Anticoagulants**: Menadione, Acetomenadione,	**0**

	Warfarin*, Anisindione, clopidogrel (Self Study)	
4	**Unit 4**	**05**
4.1	**Drugs Acting on Endocrine System** Nomenclature, Stereochemistry, and Metabolism of Steroids (self-study)	
4.2	**Sex hormones**: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol.	**01**
4.3	**Drugs for erectile dysfunction:** Sildenafil, Tadalafil (self-study)	
4.4	**Oral contraceptives:** Mifepristone, Norgestril, Levonorgestrel	**01**
4.5	**Corticosteroids:** Cortisone, Hydrocortisone, prednisone, prednisolone, Betamethasone, Dexamethasone, fluocinolone, triamcinolone	**02**
5	**Unit 5**	**08**
5.1	**Antidiabetic agents:** Insulin and its preparations Sulfonylureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. Thiazolidinediones: Troglitazone, Ciglitazone, Pioglitazone, Rosiglitazone. (Development of TZD class of antidiabetic drugs) Meglitinides: Repaglinide, Nateglinide. Glucosidase inhibitors: Acrabose, Voglibose. GLP-1 Agonist - Simaglutide SGLT-2 inhibitors- Canagliflozin, Empagliflozin DPP IV inhibitors- Linagliptin, Sitagliptin	**05**
5.2	**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*.	**03**
	Total hours	**45**

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 pharmacopeia.
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. Textbook of practical organic chemistry- A.I.Vogel.

Recommended Articles

1. Sohda T. et. al., Chem. Pharm. Bull. Soc., 1982,30, 3580.

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Course code	Course Name	Credits
BP502T	**Industrial Pharmacy I – Theory**	**4**

- **Pre-requisites**
  - Basic understanding of pharmaceutics I, physical pharmaceutics, pharmaceutical calculations, and unit processes covered under pharmaceutical engineering.

- **Course Outcomes: After the completion of the course, the learner will be able to:**
  1. Understand dosage forms and their manufacturing techniques.
  2. Understand all the related and practical aspects of solid, liquid, and semisolid dosage form development and evaluation.
  3. Correlate the theoretical knowledge with the professional and practical needs of the pharmaceutical industry.

Sr. No.	Content	Hours
1	**Unit 1: Preformulation Studies**	**07**
1.1	Introduction to preformulation, goals, and objectives, the study of physicochemical characteristics of drug substances	**01**
1.2	Physical properties: solubility profile (pKa, pH, partition coefficient), polymorphism **Self-study:** Physical form (crystal & amorphous), particle size, shape, flow properties.	**02**
1.3	Chemical Properties: Hydrolysis, oxidation, BCS classification of drugs. **Self-study:** reduction, racemization, polymerization.	**02**
1.4	Application of preformulation considerations in the development of solid, liquid oral, and parenteral dosage forms and its impact on stability of dosage forms. Drug Excipient compatibility studies.	**02**
2	**Unit 2**	**11**
2.1	**Tablets:** Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods - Wet granulation, Compression Granulation, Direct compression, tablet tooling, compression, Concept of physics of tablet compression and processing problems.	**05**
2.2	**Tablet coating**: Types of coating, coating materials, formulation of the coating composition, methods of coating, equipment employed, and defects in the coating.	**02**
2.3	**Quality control tests:** In process including evaluation of granules and finished product tests.	**02**
2.4	**Liquid orals:** Evaluation of liquid orals official in pharmacopeia. Manufacturing consideration of solutions, suspensions, and emulsions. **Self-study:** Formulation consideration of solutions, suspensions, and emulsions; Filling and packaging.	**02**

3	**Unit 3: Capsules and pellets**	**08**
3.1	**Hard gelatin capsules*:*** Introduction, production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules. In-process and final product quality control tests for capsules. **Self-study:** Extraction of gelatin.	**03**
3.2	**Soft gelatin capsules:** Nature of shell and capsule content, size of capsules, importance of base adsorption and minimum/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules	**03**
3.3	**Pellets:** Introduction, formulation requirements, pelletization process, equipment for manufacture of pellets: Twin Screw extruder and Spheronizer	**02**
4	**Unit 4**	**12**
4.1	**Parenteral Preparations:** Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity	**02**
4.2	Production procedure, production facilities and controls.	**02**
4.3	Formulation of injections, sterile powders, emulsions, suspensions, large volume parenterals and lyophilized products, **Self-study**: Sterilization.	**02**
4.4	Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests	**02**
4.5	**Ophthalmic Preparations:** Introduction, Anatomy & physiology of Eye, Ocular bioavailability, formulation considerations; formulation of eyedrops, eye ointments, methods of preparation; labelling, containers; evaluation of ophthalmic preparations	**04**
5	**Unit 5**	**07**
5.1	**Aerosols:** Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies	**04**
5.2	**Cosmetics:** Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, toothpaste, hair dyes, and sunscreens.	**03**
	Total Hours	**45**

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.
8. Introduction to Pharmaceutical Dosage Forms by H. C. Ansel, Lea & Febiger, Philadelphia, 5thedition, 2005
9. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.

Recommended Weblinks

1. https://www.lfatabletpresses.com/formulation-guide
2. https://www.saintyco.com/

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Course Code	Course Name	Credits
BP503T	**Pharmacology II - (Theory)**	**4**

- **Prerequisites:**
  - Students should possess knowledge about the following:
    - Anatomy and physiology of the different systems in the body.
    - Pathophysiology of diseases associated with the different systems of the body.
    - Information on endogenous receptors in the human body.
    - Concept of Inflammation.

- **Course Outcomes: After completion of this course students should be able to:**
  1. Classify the drugs used for cardiovascular system, urinary system and endocrine system and explain their Pharmacology.
  2. Classify and explain autacoids and related drugs and their role in inflammatory disorders like rheumatic and gout.
  3. Explain the concept of bioassay, their types, methods, and application with different examples of drugs.
  4. Apply pharmacological knowledge to diverse clinical scenarios, crafting evidence-based treatment plans and integrating multidisciplinary approaches.

Sr. No.	Content	Hours
1	**Unit 1: Pharmacology of drugs acting on cardiovascular system**	**10**
1.1	• Introduction to hemodynamic and electrophysiology of the heart. • **Drugs used in congestive heart failure**- Digoxin, dobutamine, Diuretics, RAS inhibitors, Vasodilators, β blocker, Spironolactone, eplerenone • **Anti-hypertensive drugs**- Hydrochlorothiazide, Chlorthalidone, Furosemide, Spironolactone, Captopril, Ramipril, Losartan, Candesartan, Aliskiren, Calcium channel blockers, β Adrenergic blockers, Reserpine, Labetalol, Carvedilol, Prazosin, Clonidine, Methyldopa, Hydralazine, Minoxidil, Sodium nitroprusside. • **Anti-anginal drugs**- Glyceryl trinitrate, Isosorbide dinitrate, β Blockers, Calcium channel blockers, Nicorandil, Dipyridamole, Oxyphedrine. • **Anti-arrhythmic drugs**- Quinidine, Lidocaine**,** Propafenone**,** Antiadrenergic agents, Amiodarone**,** Dofetilide**,** Calcium channel blockers, Adenosine • **Anti-hyperlipidemic drugs**- Lovastatin, Rosuvastatin, Cholestyramine, Colestipol, Bezafibrate, Gemfibrozil, Nicotinic acid, Ezetimibe.	**10**
2	**Unit 2: Pharmacology of drugs acting on cardio vascular system and urinary system**	**10**
2.1	**Pharmacology of drugs acting on cardio vascular system** • Drug used in the therapy of shock, • **Hematinics**-Oral Iron, Pareneteral Iron, Maturation Factors	**07**

	• **Coagulants**-Vitamin K, Fibrinogen, Antihemophilic factor • **Anticoagulants**- Heparin, Protamine sulphate, Bivalirudin, Warfarin, Rivaroxaban, Dabigatran etexilate • **Fibrinolytics-** Streptokinase Alteplase, Urokinase • **Anti-platelet drugs-** Aspirin Dipyridamole, Clopidogrel, Abciximab. • **Plasma volume expanders**	
2.2	**Pharmacology of drugs acting on urinary system** • **Diuretics-** Furosemide, Bumetanide, Hydrochlorothiazide, Chlorthalidone, Metolazone, Acetazolamide, Spironolactone, Eplerenone, Triamterene, Amiloride, Mannitol, Isosorbide • **Anti-diuretics-** Antidiuretic hormone, Desmopressin, Tolvaptan, thiazides.	**03**
3	**Unit 3: Autocoids and related drugs**	**10**
3.1	• Introduction to autacoids and classification • **Histamine and its antagonists** (Conventional antihistaminics, Loratadine, Fexofenadine, Cetirizine, Azelastine) • **5-HT and its antagonists** (Cyproheptadine, Methysergide, Ketanserin, Risperidone, Ondansetron) Ergot alkaloids Drug therapy of migraine • **Prostaglandins, Thromboxanes and Leukotrienes.** • **Angiotensin, Bradykinin and Substance P.** • **Non-steroidal anti-inflammatory agents-** Aspirin, Ibuprofen, Naproxen, Mephenamic acid, Piroxicam, Ketorolac, Indomethacin, Metamizol, Nimesulide, Diclofenac sodium, Meloxicam, Etodolac, Celecoxib, Etoricoxib, Paracetamol) • **Anti-gout drugs-** NSAIDs Colchicine, Corticosteroids, Probenecid, Allopurinol Sulfinpyrazone, Febuxostat. • **Antirheumatic drugs-** Methotrexate, Azathioprine, Cyclosporine, Sulfasalazine, Chloroquine, Leflunomide, Etanercept, Infliximab, Adalimumab, Anakinra, Prednisolone.	**10**
4	**Unit 4: Pharmacology of drugs acting on endocrine system**	**08**
4.1	• Basic concepts in endocrine pharmacology. • **Anterior Pituitary hormones- analogues and their inhibitors**- Growth Hormone, Somatostatin, Prolactin, Bromocriptine, Cabergoline, Gonadotropins, Gonadorelin, Nafarelin, Gnrh Antagonists, Thyrotropin, Corticotropin. • **Thyroid hormones- analogues and their inhibitors**- Thyroxine (T4), triiodothyronine (T3), Thioamides, Ionic Inhibitors, Iodine and Iodides, Radioactive Iodine, β Adrenergic Blockers • **Hormones regulating plasma calcium level**-Parathormone, calcitonin and Role of Vitamin-D. • **Insulin and its preparations, Oral Hypoglycemic agents-** Sulfonylureas, Repaglinide, Exenatide Sitagliptin, Vildagliptin ,	**08**

	Metformin, Pioglitazone , Acarbose, Bromocriptine, Dapagliflozin, Pramlintide and **glucagon**. • ACTH and corticosteroids-**Glucocorticoids**-Cortisol, prednisolone, dexamethasone, **Mineralocorticoids**-Aldosterone.	
5	**Unit 5: Pharmacology of drugs acting on endocrine system & Bioassay**	**07**
5.1	**5.1 Pharmacology of drugs acting on endocrine system** • **Androgens and Anabolic steroids.** • **Estrogens, progesterone and oral contraceptives**. • **Drugs acting on the uterus**-Oxytocics, Tocolytics.	**05**
5.2	**5.2 Bioassays** • Principles and applications of bioassay. (Self study) • Types of bioassay (Self study) • Bioassay of oxytocin, histamine and 5-HT (Self study), insulin, vasopressin, ACTH, d- tubocurarine, digitalis	**02**
	Total Hours	**45**

The syllabus encompasses prototype drugs representing their respective classes, as well as other drugs belonging to these classes, even if they are not explicitly mentioned.

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. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology.
5. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
6. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
7. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan

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Course code	Course Name	Credits
BP504T	**Pharmacognosy and Phytochemistry II - Theory**	**4**

- **Pre-requisites**
  - Basic knowledge of medicinal botany and plant metabolites
- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Describe the modern extraction process by using different methods and principles, in the isolation, purification, identification and analysis of various phyto-constituents
  2. To develop the skills of general methods of extraction, evaluation, chemical tests of crude drugs containing various secondary metabolites.
  3. Describe basic metabolic pathways and biosynthesis of various secondary metabolites through these pathways
  4. To understand utilization of radioactive isotopes in the investigation of biogenetic studies.
  5. To understand the industrial production, estimation and utilization of different classes of phytoconstituents

Sr. No.	Course Content	Hours
1	**Unit 1: Metabolic pathways in higher plants and their determination**	**07**
1.1	Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway.	
1.2	Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.	
2	**Unit 2: General introduction, composition, chemistry & chemical classes, general methods of extraction & analysis, biosources, therapeutic uses and commercial applications of following secondary metabolites**	**14**
2.1	**Alkaloids:** *Vinca, Rauwolfia, Belladonna, Opium* • Collection and method of Preparation of *Opium*	**2**
2.2	**Phenylpropanoids and Flavonoids:** Lignans, *Tea, Ruta*	**2**
2.3	**Steroids, Cardiac Glycosides & Triterpenoids**: *Liquorice, Dioscorea, Digitalis*	**2**
2.4	**Volatile oils**: *Mentha, Clove, Cinnamon, Fennel, Coriander,*	**2**
2.5	**Tannins:** *Catechu, Pterocarpus*	**1**
2.6	**Resins:** *Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony* Preparation of all resins	**2**
2.7	G**lycosides:** *Senna, Aloes, Bitter Almond*	**1**
2.8	**Iridoids, Other terpenoids & Naphthaquinones:** *Gentian, Artemisia, taxus, carotenoids* Chemistry of *Irridoids and Terpenoids,* Napthaquinone – *lawsone, shikonin*	**2**
3	**Unit 3: Isolation, identification and analysis of phytoconstituents**	**06**
	1. Terpenoids: Menthol, Citral, Artemisin 2. Glycosides: Glycyrhetinic Acid and Rutin 3. Alkaloids: Atropine, Quinine, reserpine, Caffeine 4. Resins: Phodophyllatoxin, curcumin Difference between extraction and isolation	

4	**Unit 4: Industrial production, estimation and utilization of the following phytoconstituents:**	**06**
	Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine	
5	**UNIT 5: Basics of Phytochemistry**	**12**
	Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs Conventional methods of extraction, Modern methods- SCF, Microwave, Counter current	
	Total	**45**

Recommended Books (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey.
14. Pharmacognosy and Phytochemistry by Dr Biren Shah
15. Pharmacognosy and Phytochemistry I by Dr Vinod Rangari Volume I & Volume II

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Course code	Course Name	Credits
BP505T	**Pharmaceutical Jurisprudence – Theory**	**4**

- **Pre-requisites**
  - Basic understanding of pharmaceutical formulations, manufacturing and pharmacy education.

- **Course Outcomes: After the completion of course, learner will be able to**
  1. Understand the Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.
  2. Understand the Various Indian pharmaceutical Acts and Laws
  3. Understand the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals.
  4. Understand the code of ethics during the pharmaceutical practice.

Sr. No.	Content	Hours
1	**Unit 1: Drugs and Cosmetics Act, 1940 and its rules 1945**	**10**
1.1	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.	**03**
1.2	Manufacture of drugs – Prohibition of manufacture and sale of certain drugs	**02**
1.3	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	**05**
2	**Unit 2: Drugs and Cosmetics Act, 1940 and its rules 1945.**	**10**
2.1	Detailed study of Schedule G, H, M, N, P, T, U, V, X, Y, Part XII B, Sch F & DMR (OA)	**04**
2.2	Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties	**01**
2.3	Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors, Offences and penalties.	**02**
2.4	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.	**03**
3	**Unit 3**	**10**
3.1	Pharmacy Act –1948: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and Penalties	**02**
3.2	Medicinal and Toilet Preparation Act –1955: Objectives, Definitions,	**03**

	Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. Offences and Penalties	
3.3	Narcotic Drugs and Psychotropic substances Act-1985 and Rules: Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties.	**05**
4	**Unit 4**	**08**
4.1	Study of Salient Features of Drugs and magic remedies Act and its rules: Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties.	**03**
4.2	Prevention of Cruelty to animals Act-1960: Objectives, Definitions, Institutional Animal Ethics Committee, 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.	**02**
4.3	National Pharmaceutical Pricing Authority: Drugs Price Control Order (DPCO)-2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM).	**03**
5	**Unit 5**	**07**
5.1	Pharmaceutical Legislations: A brief review, Introduction, Study of drugs Enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee	**01**
5.2	Code of Pharmaceutical ethics Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath	**02**
5.3	Medical Termination of pregnancy act	**02**
5.4	Right to information Act	**01**
5.5	Introduction to Intellectual Property Rights (IPR)	**01**
	Total Hours	**45**

Recommended Books (Latest Editions)

1. Forensic Pharmacy by B. Suresh
2. Textbook of Forensic Pharmacy by B.M. Mithal
3. Handbook of drug law-by M.L. Mehra
4. A textbook 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)

Course code	Course Name	Credits
BP506P	**Industrial Pharmacy I – Practical**	**2**

- **Pre-requisites**
  - Basic understanding of pharmaceutical calculations, formulation aspects, and unit processes covered under the subjects of physical pharmaceutics, pharmaceutics, industrial pharmacy theory, and pharmaceutical engineering.

- **Course Outcomes: After the completion of the course, the learner will be able to:**
  1. Understand all the theoretical and practical aspects of dosage form development.
  2. Formulate and evaluate solid, liquid and semisolid dosage forms.
  3. Correlate the theoretical knowledge with the professional and practical needs of the pharmaceutical industry.
  4. Plan and execute the experiments using various methodologies and systematically summarize the findings verbally and in written communication.

Sr. No.	Contents
1	Preformulation studies on paracetamol/aspirin/or any other drug
2	Preparation and evaluation of Paracetamol tablets
3	Preparation and evaluation of Aspirin tablets
4	Coating of tablets- film coating of tables/granules
5	Preparation and evaluation of Tetracycline capsules
6	Preparation of Calcium Gluconate injection
7	Preparation of Ascorbic Acid injection
8	Quality control test of (as per IP) marketed tablets and capsules
9	Preparation of Eye drops/ and Eye ointments
10	Preparation of Creams (cold / vanishing cream)
11	Evaluation of Glass containers (as per IP)
12	Preparation and evaluation of Riboflavin tablets

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.

Course Code	Course Name	Credits
BP507P	**Pharmacology II - Practical**	**2**

- **Prerequisites:**
  - Students should possess knowledge about the following:
    - Pharmacology of various drugs and physiological receptors in the body.
    - Basic knowledge about animals used in experimental pharmacology.
    - Basic knowledge about drug receptor pharmacology.

- **Course Outcomes: After completion of this course students should be able to:**
  1. Demonstrate the understanding of guidelines for animal experimentations, various routes of drug administration, and methods for blood collection from experimental animals.
  2. Apply bioassay methods effectively to determine the potency and activity of neurotransmitters and pharmacological agents, utilizing diverse animal models and tissue preparations to analyze drug responses and receptor interactions.
  3. Plan, execute and conclude the experiment using various methodologies and communicate scientific findings effectively in writing and presentations.

Sr. No.	Content
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.*/ Bioassay of acetylcholine using cock ileum by matching method.
8	Bioassay of oxytocin using rat uterine horn by interpolation method.*/ Bioassay of acetylcholine using cock ileum by interpolation method.
9	Bioassay of serotonin using rat fundus strip by three point bioassay.*/ Bioassay of acetylcholine using cock ileum 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.*
***Experiments are demonstrated by simulated experiments/videos**	

Recommended Books (Latest Editions)

1. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata
2. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan
3. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi

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Course code	Course Name	Credits
BP508P	**Pharmacognosy and Phytochemistry II - Practical**	**2**

- **Pre-requisites**
  - Basic knowledge of plant cell and Tissue
  - Basic knowledge of extraction of secondary metabolites and various methods of extraction

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Identify crude drugs based on morphological characters, microscopic characters and give biological source with the chemical constituents and therapeutic uses
  2. Apply the knowledge of microscopic characters in ascertaining the genuinely of powdered formulations.
  3. Understand the principle involved for carrying out extraction, isolation and detection of active constituents by chromatography
  4. Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management
  5. Identify unorganized drugs by qualitative chemical tests
  6. Understand principle involved in distillation of volatile oils and detection of phytoconstiuents by chromatography.

Exp. No.	Title of the Experiment
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*

Recommended Books (Latest Editions)

1. W. C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.

9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey.

Course code	Course Name	Credits
SEC_BP_501	**Spectroscopy and Chromatography Basics: A Hands-On Approach**	**-**

- **Prerequisites**
  - Fundamental knowledge of physics and chemistry

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Recall and remember the fundamental aspects of uv-visible spectroscopy and basic chromatographic techniques
  2. Operate uv-visible spectrophotometer and colorimeter instruments and perform thin layer chromatography experiments).
  3. Understand how to select operational conditions, and interpret results in practical scenarios for uv-visible spectroscopy and thin layer chromatography

Sr. No.	Content	Hours
1	**UNIT 1: Introduction and Spectroscopy Basics**	**06**
1.1	Overview of spectroscopic techniques	01
1.2	Importance and applications of UV-Visible Spectroscopy	01
1.3	Safety precautions in the laboratory	01
1.4	Theory and principles of UV-Visible spectroscopy	02
1.5	Instrumentation: components, operation, calibration	01
2	**UNIT 2: UV-Visible Spectroscopy**	**06**
2.1	Sample preparation techniques	01
2.2	Data interpretation: Beer-Lambert Law, spectral analysis	01
2.3	Hands-on training with UV-Visible spectrophotometers	02
2.4	Preparation and measurement of standard solutions	01
2.5	Data acquisition and analysis exercises	01
3	**UNIT 3: Chromatography Fundamentals**	**06**
3.1	Theory and principles of column chromatography	01
3.2	Types of stationary phases and mobile phases	01
33	Packing and preparation of chromatographic columns	01
3.4	Elution techniques and gradient elution	01
3.5	Theory and principles of thin layer chromatography	01
3.6	Types of TLC plates and development techniques	01
4	**UNIT 4: Hands-on-training: Chromatography**	**06**
4.1	Hands-on training with column chromatography setup	01
4.2	Sample loading and elution	01
4.3	Collection and analysis of fractions	01
4.4	Hands-on training with TLC plates	01
4.5	Spotting and development of samples	01
4.6	Visualization and interpretation of TLC results	01

5	**UNIT 5: Application sand Case studies**	**06**
5.1	Real-world applications of UV-Visible Spectroscopy, Column Chromatography, and TLC	01
5.2	Case studies illustrating the use of these techniques in research and industry	01
5.3	Discussion on troubleshooting and optimization in spectroscopy and chromatography experiments	01
5.4	Group or individual project where students apply concepts learned to solve an analytical problem using UV-Visible Spectroscopy, Column Chromatography, or TLC	01
5.5	Presentation of project findings	01
5.6	Course assessment and feedback	01
	Total Hours	**30**

Recommended Books (Latest Editions)

1. Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch
2. Introduction to Spectroscopy by Donald L. Pavia, Gary M. Lampman, and George S. Kriz
3. Chromatography: Concepts and Contrasts by James M. Miller and Jane C. Miller
4. Modern Spectroscopy by J. Michael Hollas
5. Liquid Chromatography: Fundamentals and Instrumentation by Salvatore Fanali, Paul R. Haddad, and Colin F. Poole
6. Interpretation of Organic Spectra by Y. R. Sharma

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Semester VI

Course code	Course Name	Credits
BP601T	**Medicinal Chemistry III – Theory**	**4**

- **Pre-requisites**
  - Familiarity with biological systems and physiological processes relevant to pharmacology.
  - Familiarity with biochemistry concepts such as enzyme kinetics, protein structure, and metabolic pathways.
  - Proficiency in interpreting chemical structures and understanding stereochemistry.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand the chemistry of drugs concerning their pharmacological activity.
  2. Classify drugs based on their structure/ mechanism of action/ site of action.
  3. Understand the drug metabolic pathways, adverse effects, and therapeutic value of drugs.
  4. Know the Structural Activity Relationship of different classes of drugs.
  5. Study the chemical synthesis of selected drugs.
  6. Know the various approaches in drug design.

Note: 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 (*)		
Sr. No.	**Content**	**Hours**
1	**Unit 1: Antibiotics (Natural and Semi-synthetic Antibiotics)**	**13**
1.1	**Historical background, Nomenclature, Stereochemistry, Structure-activity relationship, Chemical degradation classification, and important products of the following classes.** β-Lactam antibiotics: a. Penicillins (natural and semisynthetic penicillins like Penicillins G, Penicillins V, ampicillin*, amoxicillin, cloxacillin*, oxacillin, nafcillin, methicillin, and ampicillin; prodrugs like bacampicillin and hetacillin) b. Cephalosporins (cephalexin, cefadroxil, cefazolin, cefamandole, cefoxitin, cefuroxime, cefotaxime, ceftriaxone, cefpodoxime proxetil, cefepime) c. β Lactamase inhibitors (Clavulanic acid, tazobactam, enmetazobactam) d. Monobactams (Aztreonam, Tigemonam - Only structural features), e. Carbapenems (Emepenem, Meropenem - Only structural features)	**07**
1.2	**Tetracyclines:** Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline and its prodrug – rolitetracycline, Doxycycline	**03**
1.3	**Aminoglycosides:** Streptomycin, Neomycin, Kanamycin (Only structural	**01**

	features)	
1.4	**Macrolide:** Erythromycin Clarithromycin, Azithromycin. (Only structural features)	**01**
1.5	**Miscellaneous:** Chloramphenicol*, Clindamycin, Mupirocin	**01**
2	**Unit 2: Antibiotics (Synthetic)**	**06**
2.1	Historical background, Nomenclature, Stereochemistry, Structure-activity relationship, Chemical degradation classification, and important products of the following classes. **Sulphonamides and Sulfones:** Historical development, chemistry, classification and SAR of Sulfonamides: a. Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxaole*, Sulphadiazine, Mefenide acetate, Sulfasalazine. b. **Folate reductase inhibitors:** Trimethoprim*, Cotrimoxazole c. **Sulfones:** Dapsone*.	**03**
2.2	**Urinary tract anti-infective agents:** a. **Quinolones:** SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin b. **Miscellaneous:** Furazolidine, Nitrofurantoin*, Methanamine.	**03**
3	**Unit 3: Anti-tubercular and antiviral agents**	**07**
3.1	**Anti-tubercular Agents:** a. **Synthetic anti tubercular agents:** Isoniozid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid*, Bedaquiline. b. **Anti-tubercular antibiotics:** Rifampicin, Rifabutin, Cycloserine, Streptomycin, Capreomycin sulphate.	**03**
3.2	**Antiviral agents:** Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Valacyclovir, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Protease inhibitors: Development of Saquinavir, Indinavir, Ritonavir. EGFR inhibitors Imatinib	**04**
4	**Unit 4: Anti-fungal anti-parasitic agents**	**10**
4.1	**Antifungal agents:** a. **Antifungal antibiotics:** Amphotericin-B, Nystatin, Natamycin, Griseofulvin. b. **Synthetic Antifungal agents:** Clotrimazole, Econazole, Butoconazole,Oxiconazole Tioconozole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Luliconazole, Naftifine hydrochloride, Tolnaftate*.	**03**
4.2	**Antimalarials:** Etiology of malaria.	**05**

	a. **Quinolines:** SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine. halofantrine b. **Biguanides and dihydro triazines:** Cycloguanil pamoate, Proguanil. c. **Miscellaneous:** Pyrimethamine, Artesunete, Artemether, Atovoquone.	
4.3	**Anti-protozoal Agents:** Metronidazole*, Tinidazole, Ornidazole, Diloxanide,Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine.	**01**
4.4	**Anthelmintics:** Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquinal, Ivermectin	**1**
5	**Unit 5: Anticancer**	**09**
5.1	**Anti-neoplastic agents:** **Alkylating agents:** Mechlorethamine* Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa **Antimetabolites:** Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine **Antibiotics:** Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin **Plant products:** Etoposide, Vinblastin sulphate, Vincristine sulphate (Structures not to be studied) **Miscellaneous:** Cisplatin, Mitotane (Self Study) Histone Deacetylase Inhibitors: romidepsin, vorinostat Tyrosine Kinase Inhibitors: imatinib, dasatinib, lapatinib	**09**
	Total Hours	**45**

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. Textbook of practical organic chemistry- A.I.Vogel.
11. An introduction to Medicinal Chemistry by Graham Patrick
12. Organic Chemistry of Drug Design by Richard Silverman

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Course Code	Course Name	Credits
BP602T	**Pharmacology III - Theory**	**4**

- **Prerequisites:**
  - Students should possess knowledge about the following:
    - Knowledge of fundamental principles of pharmacology.
    - Basic understanding of pathogenic microorganisms, common infections, and cancer pathophysiology.
    - Knowledge of the anatomy and physiology of the respiratory and gastrointestinal systems, and associated disorders.
    - Basic knowledge of the immune system and the signalling pathways engaged in immune responses.
    - Basic understanding of circadian rhythm.

- **Course Outcomes: After completion of this course students should be able to:**
  1. Show comprehensive understanding of the pharmacology of gastro-intestinal drugs, respiratory drugs, chemotherapy, immunomodulators, toxicology, and assess various pharmacotherapeutic strategies considering efficacy, safety, and clinical relevance.
  2. Explain advanced pharmacological concepts, including pharmacogenomics, drug repurposing and chronopharmacology, to understand personalized medicine and innovative therapeutic strategies.
  3. Apply pharmacological knowledge to diverse clinical scenarios, crafting evidence-based treatment plans and integrating multidisciplinary approaches.

Sr. No.	Content	Hours
1	**Unit 1: Drugs acting on Respiratory system and Gastrointestinal Tract**	**10**
1.1	**Pharmacology of drugs acting on Respiratory system** a. **Anti -asthmatic drugs and Drugs used in the management of COPD**: Salbutamol, Terbutaline, Ipratropium bromide, Theophylline, Montelukast, Sodium cromoglycate, Ketotifen, Systemic and inhalational corticosteroids, Omalizumab. b. **Expectorants and antitussives** **c. Nasal decongestants** **d. Respiratory stimulants**	**05**
1.2	**Pharmacology of drugs acting on the Gastrointestinal Tract** a. **Antiulcer agents**- Cimetidine, Omeprazole, Pirenzepine, Misoprostol, Antacids, Sucralfate, Colloidal bismuth subcitrate, Anti-H. pylori drugs. b**. Drugs for constipation**- Bulk forming, Stool softener, Stimulant purgatives, Osmotic purgatives - and diarrhoea. c. **Appetite stimulants and suppressants.** d.**Digestants and carminatives (Self-study)**	**05**

	e. **Emetics-** Apomorphine, Ipecacuanha and **anti-emetics**- Hyoscine, Dicyclomine, Promethazine, Diphenhydramine, Chlorpromazine, Prochlorperazine, Haloperidol, Metoclopramide, Domperidone, Cisapride, Mosapride, Itopride, Ondansetron, Aprepitant, Dexamethasone, Benzodiazepines, Dronabinol, Nabilone	
2	**Unit 2: Chemotherapy I**	**10**
2.1	a. General principles of chemotherapy-classification, problems that arise with the use of AMR and antimicrobial stewardship, choice of an antimicrobial agent, combined use of antimicrobials. b. **Sulfonamides and cotrimoxazole.** **c. Antibiotics-** • Penicillins (Penicillin G, Penicillin V, Cloxacillin, Amoxicillin, Carbenicillin, Piperacillin, β-lactamase inhibitors- Clavulanic acid), • Cephalosporins • Chloramphenicol • Macrolides-Azithromycin, Erythromycin. • Quinolones-Nalidixic acid and fluoroquinolone- Ciprofloxacin, • Tetracycline and • Aminoglycosides-Streptomycin.	**10**
3	**Unit 3: Chemotherapy II**	**10**
3.1	a. **Antitubercular Agents**-First line drugs, Second line drugs- Fluoroquinolones, Injectable drugs b. **Antileprotic agents**- Dapsone, Clofazimine, Ethionamide. Multidrug therapy (MDT) of leprosy. c**. Antifungal Agents**-Amphotericin B (AMB), Caspofungin, Griseofulvin, Flucytosine, Clotrimazole, Ketoconazole, Fluconazole, Itraconazole, Terbinafine, Undecylenic acid, Quiniodochlor, Ciclopirox olamine, Tolnaftate. d. **Antiviral drugs**- • Anti-Herpes Virus-Acyclovir, Foscarnet • Anti-Influenza virus Amantadine, Oseltamivir • Anti-Hepatitis virus-hepatitis B: Lamivudine, Adefovir dipivoxil, hepatitis C: Interferon α • Anti-Retrovirus-Zidovudine, Emtricitabine, Nevirapine, Efavirenz, Saquinavir, Enfuvirtide, Maraviroc, Raltegravir, HIV treatment principles and guidelines e. **Anthelmintics:** Diethylcarbamazine citrate, Thiabendazole, Mebendazole, Albendazole, Niclosamide, Oxamniquine, Praziquinal, Ivermectin f. **Antimalarial agents**-Chloroquine, Mefloquine, Quinine, Proguanil, Pyrimethamine, Primaquine, Sulfadoxine, Sulfamethopyrazine, Dapsone, Tetracycline, Sesquiterpine lactones, Halofantrine, Pyronaridine, Atovaquone, ACT. g. **Anti-amoebic Agents** - Metronidazole, Emetine, Diloxanide furoate, Nitazoxanide, Quiniodochlor, Diiodohydroxyquin, Paromomycin	**10**

4	**Unit 4: Chemotherapy III and Immunopharmacology**	**08**
4.1	**Chemotherapy of Malignancy**-Cytotoxic drugs, Targeted drugs, Hormonal drugs **Chemotherapy of Urinary tract infections and sexually transmitted diseases (Self Study)**	**03**
4.2	**Immunopharmacology** **a. Immunostimulants** **b.Immunosuppressant**-Cyclosporine, Tacrolimus, Sirolimus, Azathioprine, Methotrexate, Prednisolone, Mycophenolate mofetil, Biological agents. c. **Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars**	**05**
5	**Unit 5: Toxicology and Chronopharmacology**	**04**
5.1	**Toxicology** a. Definition and basic knowledge of acute, subacute and chronic toxicity **(Self Study)** b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity c. General principles of treatment of poisoning d. Clinical symptoms and management of lead, mercury and arsenic poisoning, and barbiturates, morphine, organophosphosphorus compound poisoning **(Self-study**)	**03**
5.2	**Chronopharmacology** a. Definition of rhythm and cycles. b. Biological clock and their significance leading to chronotherapy of Asthma, Peptic ulcer, Rheumatoid arthritis, and Diabetes mellitus.	**01**
6	**Unit 6: Pharmacogenomics and Drug repurposing**	**03**
6.1	**Pharmacogenomics** Definition, Identifying genetic contributors to variable drug actions, Variable drug actions and single gene variants	**02**
6.2	**Drug Repurposing** Definition, strategies for repurposing, repositioned drug examples, challenges	**01**
	Total Hours	**45**

The syllabus encompasses prototype drugs representing their respective classes, as well as other drugs belonging to these classes, even if they are not explicitly mentioned.

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. K. D. Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.

5. Satoskar and Bhandarkar, Pharmacology and Pharmacotherapeutics Pharmacology (Lippincott's Illustrated Reviews Pharmacology)

Recommended Articles:

1. Genotoxicity: Mechanisms, Testing Guidelines and Methods. Global journal of Pharmacy & pharmaceutical Science ISSN:2573-2250, SAKS *et al.*
2. A Systematic Review: Pathogenesis of Peptic Ulcer and Role of Chronotherapy in Its Treatment, Review Article - Der Pharma Chemica (2020) Volume 12, Issue 1, Dhakad P *et al*.
3. Drug Repurposing (DR): An Emerging Approach in Drug Discovery DOI: http://dx.doi.org/10.5772/intechopen.93193
4. Pharmacogenomics: The genetics of variable drug responses. Circulation. 2011 April 19; 123(15): 1661–1670. doi:10.1161/CIRCULATIONAHA.109.914820

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Course code	Course Name	Credits
BP603T	**Herbal Drug Technology – Theory**	**4**

- **Pre-requisites:** Basic principles of Pharmacognosy
- **Course Outcomes:** After the completion of course, learner will be able to:

1. To understand herbs as raw materials and its processing to produce herbal drug product.
2. Understand and apply the significance of excipients of natural origin, used in pharmaceutical formulations and describe various classes of excipients
3. Apply the knowledge of pharmacology to understand pharmacodynamic and pharmacokinetic herb-drug and herb-food interactions
4. Attain the knowledge of health benefits of nutraceuticals, herbal cosmetics, conventional and novel herbal formulations.
5. To understand and demonstrate patenting, regulatory requirements and evaluation of natural products.

Sr. No.	Course Contents	Hours
Unit 1:		
1.1	**Herbs as raw materials:** Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs Selection, identification and authentication of herbal materials Processing of herbal raw material Modern Methods of authentication	**3**
1.2	**Biodynamic Agriculture** Good agricultural practices in cultivation of medicinal plants including Organic farming.Pest and Pest management in medicinal plants: Biopesticides/ Bioinsecticides	**3**
1.3	**Indian Systems of Medicine** Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy Preparation and standardization of Ayurvedic formulations viz Aristas and Asavas, Gjutika, Churna, Lehya and Bhasma	**5**
Unit 2:		
2.1	**Nutraceuticals** General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. Marketed preparations of Nutraceuticals	**2**
2.2	Study of following herbs as health food: *Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina*	**2**
2.3	**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, Ginkgo Biloba, Ginseng, Garlic, Pepper & Ephedra*. Classification of Herb-Drug Interactions	**3**
Unit 3:		

3.1	**Herbal Cosmetics** Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.	**4**
3.2	Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes**.**	**3**
3.3	**Herbal formulations :** Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes Difference between liposomes and phytosomes	**3**
Unit 4:		
4.1	**Evaluation of Drugs** WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs.	**2**
4.2	**Patenting and Regulatory requirements of natural products:** a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem. Case study of traditional medicine/ agricultural product patent revocation cases in India: Make a report	**5**
4.3	**Regulatory Issues –** Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs	**3**
Unit 5:		
5.1	**General Introduction to Herbal Industry** Herbal drugs industry: Present scope and future prospects. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.	**3**
5.2	**Schedule T–Good Manufacturing Practice of Indian systems of medicine** Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records.	**4**
	Total Hours	**45**

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.
8. Sathya S., Jaiganesh K. P., Sudha T. Current Trends in Herbal Drug Technology, PeeVee Publications, India 2020.
9. Arunachalam G., Ida Christi V. E., Kumar P., Herbal Drug Technology, Thakur Publication Pvt. Ltd., Lucknow 2019-20

Course code	Course Name	Credits
BP604T	**Biopharmaceutics and Pharmacokinetics – Theory**	**4**

- **Pre-requisites**
  - Basic knowledge of human anatomy and physiology and basic principles of physical pharmacy.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
  2. Use plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
  3. Understand the concepts of bioavailability and bioequivalence of drug products and their significance.
  4. Understand various pharmacokinetic parameters, their significance & applications

Sr. No.	Content	Hours
1	**Unit 1**	**10**
1.1	Introduction to Biopharmaceutics	**01**
1.2	Absorption; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes	**04**
1.3	Distribution of Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution,	**03**
1.4	Protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs	**02**
2	**Unit 2**	**10**
2.1	Drug Elimination renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, non-renal routes of drug excretion of drugs.	**02**
2.2	Bioavailability and Bioequivalence: Definition and Objectives of bioavailability studies	**01**
2.3	Absolute and relative bioavailability, measurement of bioavailability, measurement of bioavailability,	**02**
2.4	In-vitro drug dissolution models,	**02**
2.5	In-vitro, in-vivo correlations, bioequivalence studies	**02**
2.6	Methods to enhance the bioavailability of poorly soluble drugs.	**01**
3	**Unit 3:** Pharmacokinetics:	**13**
3.1	Definition and introduction of pharmacokinetics, compartment models, non-compartment models, physiological models.	**03**
3.2	One compartment open model. a. Intravenous Injection (Bolus) b.	**10**

	Intravenous infusion, extra vascular administrations, calculations of Ka, KE, t1/2, Vd, AUC, Ka, Clt and CLr- definition methods of elimination, understanding of their significance and application, Urinary excretion methods for determination of pharmacokinetic parameters: Rate of excretion method, sigma minus method	
4	**Unit 4:** Multicompartment models:	**05**
4.1	Two compartment open model. IV bolus	**02**
4.2	kinetics of Multiple dosing, steady state drug level, calculation of loading and maintenance dose and their significance in clinical setting	**03**
5	**Unit 5**	**07**
5.1	**Nonlinear Pharmacokinetics:** a. Introduction, b. Factors causing non-linearity. c. Michaelis-Menten method of estimating parameters,	**04**
5.2	Biotransformation of drugs	**03**
	Total Hours	**45**

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
4. 4 th edition,Prentice-Hall Inernational edition.USA
5. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and
6. Sunil B.Jaiswal,Vallabh Prakashan Pitampura, Delhi
7. Pharmacokinetics: By Milo Glbaldi Donald, R. Mercel Dekker Inc.
8. Handbook of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.
9. Biopharmaceutics; By Swarbrick
10. Clinical Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.
11. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company, Pennsylvania 1989.
12. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn, New York and Basel, 1987.
13. Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvnia

Course code	Course Name	Credits
BP605T	**Pharmaceutical Biotechnology – Theory**	**4**

- **Pre-requisites**
  - Basic knowledge about Biochemistry and Microbiology

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand the tools, techniques, ethics and environmental safety involved in gene cloning, and the applications of Recombinant DNA technology.
  2. Discuss basics of immunology and explain the antigen-antibody interactions and defense mechanism and explain technique of monoclonal antibodies production for treating the human diseases.
  3. Apply fermentation principles for optimizing vaccine and antibiotic production, ensuring safety and efficacy of the product.
  4. Demonstrate different techniques and applications of enzyme immobilization and cell culture.

Sr. No.	Content	Hours
1	**Unit 1**	**03**
1.1	Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.	**01**
1.2	Genetic organization of Eukaryotes and Prokaryotes	**01**
1.3	Basic principles of genetic engineering. (Introduction and Ethics in Biotechnology)	**01**
2	**Unit 2**	**14**
2.1	Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.	**02**
2.2	**Mutation:** Types of mutation (Spontaneous mutation and Induced mutation) mutants (7 types).	**02**
2.3	Study of cloning vectors, restriction endonucleases and DNA ligase (Tools of genetic Eng., steps involved, expression system)	**02**
2.4	Recombinant DNA technology. Application of genetic engineering in medicine (Transgenic plants, Animals and Microbes, Gene therapy, RFLP, DNA fingerprinting, DNA Sequencing, Maxam-Gilbert, Sanger's method)	**05**
2.5	Brief introduction to PCR (define RT PCR)	**01**
2.6	Application of r DNA technology and genetic engineering in the production of i) Interferon (Not in details) ii) Vaccines- hepatitis-B, (Covishield, Sputnik-V Brief RNA based vaccines) iii) Hormones- Insulin.	**02**
3	**Unit 3**	**04**

3.1	Large scale production fermenter design and its various controls.	**01**
3.2	Fermentation methods (continuous, batch, fed batch) and general requirements, Study of media, equipments (Types of fermenters: Mechanical stirred tank, Fluidized bed, Gas/Air lift), Sterilization methods, Aeration process, Stirring.	**02**
3.3	Study of the production of - penicillins, Vitamin B12, **Self-Study:** Glutamic acid, Griseofulvin, citric acid	**01**
4	**Unit 4**	**06**
4.1	Enzyme Biotechnology- Methods of enzyme immobilization and applications.	**03**
4.2	Biosensors- Working and applications of biosensors in Pharmaceutical Industries. Examples of Industrial Biosensors like Glucometer, Penicillinase biosensor etc.	**01**
4.3	Brief introduction to Protein Engineering.	**01**
4.4	Use of microbes in industry. Production of Enzymes- General consideration -Amylase, Catalase, Peroxidase, **Self-study**: Lipase, Protease, Penicillinase.	**01**
5	**Unit 5**	**12**
5.1	Types of immunity- humoral immunity, cellular immunity	**01**
5.2	Structure of Immunoglobulins and their types	**01**
5.3	Structure and Function of MHC	**01**
5.4	Hypersensitivity reactions- Principle, mechanism and examples, Immune stimulation and Immune suppressions.	**02**
5.5	Hybridoma Technology- Production, Purification and Applications (Upstream and downstream Processing in the Production of monoclonal antibodies)	**02**
5.6	Immunoblotting techniques- Western blotting, Southern blotting. (Define: Northern blotting)	**02**
5.7	Labelled Antigen Antibody Reactions -ELISA, RIA and Fluorescent labelled reactions and their applications	**02**
5.8	Brief Introduction to autoimmune disorders	**01**
6	**Unit 6**	**06**
6.1	General method of the preparation of bacterial vaccines (Seed lot system), toxoids, viral vaccine (Covaxin), antitoxins, serum-immune blood derivatives and other products relative to immunity. (Diphtheria toxoid, diphtheria antitoxin, polio vaccine, vaccine classification)	**03**
6.2	Storage conditions and stability of official vaccines	**01**
6.3	**Blood Products:** Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substitutes.	**02**
	Total Hours	**45**

Recommended Books (Latest Editions)

1. R. C. Dubey, A textbook of biotechnology

2. B. D. Singh, Biotechnology.
3. S. P. Vyas and Dixit, Pharmaceutical Biotechnology, CBS publisher & distributers.
4. S. S. Kori, Pharmaceutical Biotechnology.
5. H. D. Kumar, Biotechnology, Affiliate East-West press Pvt. Ltd New Delhi.
6. Ananthnarayan, A textbook of microbiology, Orient Longman Pvt. Ltd.
7. W. B. Hugo and A. D. Russell, Pharmaceutical Microbiology, Blackwell Science.
8. David, Nelson, Lehninger - Principle of Biochemistry, W. H. Freeman & Co.
9. Pelezar, Chan & Krieg, Microbiology-Concepts and Applications, International Edn., McGraw Hill, Inc.,
10. Weir Stewart: Immunology, Churchill Livingstone.
11. Chandrakant Kakote, Pharmaceutical Biotechnology.
12. Desmond S.T. Nicholl, An introduction to genetic engineering, Panima Publishing Corporation, New Delhi.
13. Stanbury F. P., Whitakar A., and Hall J.S. Principles of fermentation technology,2nd edition. Aditya books LTD., New Delhi.

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Course code	Course Name	Credits
BP606T	**Pharmaceutical Quality Assurance – Theory**	**4**

- **Pre-requisites**
  - Basic knowledge of pharmaceutical product development and quality control tests.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand the concepts of quality assurance, total quality management, ICH guidelines, and quality by design
  2. Understand the organization, premises planning, and pharmaceutical industry resources.
  3. Apply the principles of quality control and good laboratory practices during practical training.
  4. Evaluate and apply document maintenance and complaint handling to practical situations.

Sr. No.	Content	Hours
1	**Unit 1**	**10**
1.1	**Quality Assurance and Quality Management concepts:** Definition and concept of Quality control, Quality assurance and GMP	**02**
1.2	**ICH Guidelines**: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines	**02**
1.3	**Total Quality Management (TQM):** Definition, elements, philosophies	**01**
1.4	**QbD**: Definition, overview, elements of QbD program, tools	**03**
1.5	**ISO 9000 & ISO14000**: Overview, Benefits, Elements, steps for registration **NABL accreditation**: Principles and procedure	**02**
2	**Unit 2:**	**10**
2.1	**Organization and personnel:** Personnel responsibilities, training, hygiene, and personal records.	**03**
2.2	**Premises:** Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.	**04**
2.3	**Equipment and raw materials:** Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials	**03**
3	**Unit 3**	**10**
3.1	**Quality Control:** Quality control test for containers, rubber closures and secondary packing materials	**04**
3.2	**Good Laboratory Practices:** General Provisions, Organization and	**04**

	Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles	
3.3	Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities	**02**
4	**Unit 4**	**08**
4.1	**Complaints:** Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.	**04**
4.2	**Document maintenance in pharmaceutical industry:** Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.	**04**
5	**Unit 5**	**07**
5.1	**Calibration and Validation:** Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation. **Self-Study:** Calibration of pH meter	**05**
5.2	**Warehousing:** Good warehousing practice, materials management, Introduction to supply chain Management	**02**
	Total Hours	**45**

Recommended Books (Latest Editions)

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

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Course code	Course Name	Credits
BP607P	**Medicinal Chemistry III – Practical**	**2**

- **Pre-requisites**
  - Organic Chemistry lab safety and general procedures, heating, filtration, adjusting pH and determination of physical constants.
- **Course Outcomes: Upon completion of the course learner will be able to:**
  1. Perform Synthesis of Some drugs and intermediates
  2. Perform Assay of drugs
  3. Apply principles of Green Chemistry for organic synthesis
  4. Apply computational techniques in pharmaceutical chemistry.

Unit I:	**Preparation of drugs and intermediates**
1. Sulphanilamide 2. 7-Hydroxy, 4-methyl coumarin 3. Chlorobutanol 4. Triphenyl imidazole 5. Tolbutamide 6. Hexamine	
Unit II:	**Assay of drugs**
1. Isonicotinic acid hydrazide 2. Chloroquine 3. Metronidazole 4. Dapsone 5. Chlorpheniramine maleate 6. Benzylpenicillin	
Unit III:	Preparation of Aspirin and Phenytoin by Microwave irradiation technique
Unit IV:	Drawing structures and reactions using chem draw®/ChemSketch
Unit V:	Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors, and acceptors for the class of drugs in course content drug design software Drug likeliness screening (Lipinski's RO5)
Unit VI	Determination of toxicological potential in terms of Organ Toxicity (hepatotoxicity, nephrotoxicity, cardiotoxicity, neurotoxicity) and Toxicity endpoints (Carcinogenicity, Immunotoxicity, Mutagenicity, Cytotoxicity) using ProTox 3.0 - Prediction of Toxicity of Chemicals

Recommended Books (Latest Editions)

1. Wilson and Griswold's Organic Medicinal and Pharmaceutical Chemistry.
2. Faye'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. Textbook of practical organic chemistry- A.I.Vogel.

Recommended Weblinks

1. **http://www.swissadme.ch/**
2. **https://tox.charite.de/protox3/index.php?site=home**

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Course Code	Course Name	Credits
BP608P	**Pharmacology III - Practical**	**2**

- **Prerequisites:**
  - Students should possess knowledge about the following:
    - Basic mathematical skills
    - Concepts of agonist and antagonist
    - Basic knowledge of preclinical toxicity studies

- **Course Outcomes: After completion of this course students should be able to:**
  1. Solve the problems based on dose calculation in pharmacological experiments, calculation of pharmacokinetic parameters, student's t test, ANOVA test, Chi square test, Wilicoxin Signed Rank test.
  2. Demonstrate proficiency in conducting acute toxicity testing, including understanding the principles of dose selection, route of administration, observation periods, and data interpretation according to regulatory guidelines.
  3. Plan, execute and conclude the experiment using various in vitro and in vivo methodologies and communicate scientific findings effectively in writing and presentations.

Sr. No.	Content
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 agonists and antagonists on guinea pig ileum.
6.	Estimation of serum biochemical parameters by using a semi auto analyser.
7.	Effect of saline purgative on frog intestine.
8.	Insulin hypoglycemic effect in rabbits.
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).
16.	Invitro antioxidant assay.
17.	Study of antiurolithiatic activity by nucleation aggregation assay.

18.	Invitro lipase activity assay.

Recommended Books (Latest Editions)

1. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata
2. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan
3. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier
4. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
5. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
6. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology
7. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.

Recommended Articles:

1. Antiurolithiatic Potential of Three Sri Lankan Medicinal Plants by the Inhibition of Nucleation, Growth, and Aggregation of Calcium Oxalate Crystals In Vitro, https://doi.org/10.1155/2022/8657249
2. In Vitro Antioxidant Activities of Methanolic Extracts of Caesalpinia volkensii Harms., Vernonia lasiopus O. Hoffm., and Acacia hockii De Wild,https://doi.org/10.1155/2020/3586268
3. Phytochemical analysis of Canna indica L. roots and rhizomes extract.https://doi.org/10.1016/j.bbrep.2018.09.002

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Course code	Course Name	Credits
BP609P	**Herbal Drug Technology - Practical**	**2**

- **Pre-requisites:** Basic knowledge of ayurvedic and herbal formulations
- **Course Objectives:**

1. To extract and perform qualitative chemical tests belonging to various classes of phytoconstituents
2. To apply knowledge of analytical procedures in quantitative determination of total aldehyde content, phenol content, total alkaloids from crude drugs
3. To learn evaluation of excipients of natural origin
4. To study monograph analysis of herbal drugs from recent official compendia
5. To assess ayurvedic dosage form, herbal formulations and herbal cosmetics as per official compendia.

Exp. No.	Title of the Experiment
1.	Preliminary Phytochemical Screening of Crude Drugs
2.	Determination of Phenol Content
3.	Preparation and Evaluation of Vasaka Syrup
4.	Preparation and Evaluation of Moisturising Turmeric Cream
5.	Preparation and Evaluation of Digestive Churna Mixture
6.	Preparation and Evaluation of Herbal Lotion
7.	Preparation and Evaluation of Herbal Shampoo
8.	Determination of the Alcohol Content of Asava or Arista
9.	Determination of Aldehyde Content in Cinnamon Oil
10.	Evaluation of Excipients of Natural Origin
11.	Monograph Analysis of Herbal Drugs
12.	Preparation and Evaluation of Liquorice Tablets
13.	Determination of Alkaloid Content
14.	Determination of Total Tannin Content in marketed formulations
15.	Test for steroids in herbals/herbal formulation
16.	Test for Heavy Metal adulteration in herbal formulations

Recommended Books (Latest Editions)

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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

Semester VII

Course code	Course Name	Credits
BP701T	**Instrumental Methods of Analysis - Theory**	**4**

- **Pre-requisites**
  - Liquid-liquid extraction- Partition coefficient, molecular diffusion, mass transfer
  - Adsorption, adsorption isotherms, quantum theory, difference between protons, neutrons and electrons
  - Structure of atoms, atomic orbitals and energy associated, structure of molecules, molecular orbitals and their energy, different types of molecular bonds, molecular orbital theory
  - Electromagnetic radiation, origin, nature of EMR, energy of EMR and propagation of EMR, photoelectric effect
  - Adsorption coefficient, partition coefficient, vapor pressure, partial pressure, polarity of molecules, solubility of gases in liquids

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Recall with examples the terminologies associated with spectroscopy and chromatography
  2. Explain and illustrate the theory, instrumentation and applications of UV visible spectroscopy, fluorimetry, IR spectroscopy, HPLC, GC, paper chromatography, TLC, ion chromatography, gel chromatography and affinity chromatography and electrophoresis
  3. Read and interpret simple Atomic/ UV/ Fluorescence spectra and HPLC/ GC chromatograms to arrive at various spectroscopic or chromatographic parameters respectively and read and interpret simple IR spectra to predict presence/ absence of structural features in the analyte molecule
  4. Select a suitable spectroscopic and/or chromatographic technique based on the nature of an analyte and analytical problem
  5. Predict the spectroscopic behaviour of simple organic molecules

Sr. No.	Content	Hours
1	**Unit 1: UV Visible spectroscopy**	**11**
1.1	• **Terms:** Electromagnetic radiation, Visible light, electromagnetic spectrum, molecular spectra, absorption spectroscopy, wavelength, wave number, frequency, absorbance, transmittance, auxochrome, bathochromic shift, hypsochromic shift, hyperchromic, hypochromic, wavelength maxima, specific absorbance, molar absorptivity, cut-off wavelength for solvents, isoabsorptive point, spectral bandwidth • **Concept:** Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert ‘s law, Derivation and deviations	**03**

1.2	• **Instrumentation** - Sources of radiation, wavelength selectors, sample cells, detectors-Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode. Colorimeter and UV-VIS spectrophotometer (single beam and double beam with diagram)	**02**
1.3	• **Applications** - Spectrophotometric titrations, Single component and multi component analysis (simultaneous estimation, absorbance ratio and difference spectroscopy)	**02**
1.4	**Fluorimetry:** • **Theory:** Origin of fluorescence and phosphorescence spectra. Fundamental equation for fluorescence intensity. Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, • **Instrumentation:** Filter fluorimeter and Spectrofluorometer (including Block diagram), Sources of radiation, Monochromators (Filters, gratings), Sample cells, Detectors • **Applications:** Fluorescent compounds and non-fluorescent compounds (Chemical derivatization to fluorescent compound, e.g. use of Dansyl chloride, Fluoresamine, o-phthalaldehyde) & Choice of fluorimetry over UV-Vis spectroscopy with respect to Sensitivity and Specificity	**04**
2	**Unit 2: IR spectroscopy**	**11**
2.1	• **Introduction,** I.R regions, requirements for I.R. absorption, vibrational and rotational transitions, dipole changes, types of molecular vibrations, potential energy diagrams (harmonic oscillator and anharmonic oscillator), Vibrational frequency, force constants, fundamental modes of vibrations in poly atomic molecules, factors affecting vibrations, fingerprint region • **Sample handling:** Sample preparation for Solids (mulling, pelleting and thin film deposition, and in solution form), Liquids (Neat and in solution form). Sample handling: Attenuated Total Reflectance and Diffuse Reflectance.	**02**
2.2	• **Instrumentation** - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications • **Instrumentation of FTIR** • **Pharmaceutical applications of IR spectroscopy** (including characteristic IR absorption frequencies of some common bond types such as hydroxyl stretch, nitrile stretch and carbonyl stretch of aldehydes and ketones, aliphatic and aromatic C-H stretch) **Pharmaceutical applications of Near IR spectroscopy including PAT (Process Analytical Techniques)** • **Introduction to Raman spectroscopy,** Comparison between IR and Raman spectroscopy	**05**

2.3	**Flame Photometry-** • **Principle** • **Interferences:** Cationic, Anionic and Physical interferences in Flame photometry • **Instrumentation:** Flame atomization (types of flames, flame structure, flame atomizers) • **Applications**	**1.5**
2.4	**Atomic absorption spectroscopy** • Principle • Interferences: Spectral Interferences and Chemical Interferences in AAS • Instrumentation: Radiation sources (Hollow cathode lamp, Electrode discharge lamps), Plasma sources: Inductively coupled plasma and Direct current plasma source • Applications	**1.5**
2.5	**Nepheloturbidometry-** Principle, instrumentation, and applications	**01**
3	**Unit 3: Introduction to chromatography**	**12**
3.1	• **Concept of chromatography:** Terminologies: stationary phase, mobile phase, retention time, gradient and isocratic elution, normal and reverse phase chromatography, planar chromatography, retention factor, chromatogram, internal standard, reference standard, working standard, tailing factor (symmetry factor), asymmetry factor, resolution, signal to noise ratio, column chromatography, preparative chromatography. • **Classification of chromatographic methods (Self-study-0.5 hr)** • **Quantitative analysis** (Peak height, peak areas, calibration curve, internal standard, and area normalization). • **Optimization of column performance** (Column efficiency and band broadening, shape of peak-Gaussian, Plate height, Number of theoretical plates, van Deemter equation, Capacity factor, Selectivity factor, Tailing factor, peak width, and Resolution • **Numericals and justification-based problems related to column performance** • **Adsorption and partition column chromatography:** Methodology, advantages, disadvantages, and applications	**05**
3.2	**Thin layer chromatography-** • Introduction, Principle, Methodology, Rf values • **Developmental techniques** • Visualisation techniques, factors affecting resolution • Advantages, disadvantages • Applications: TLC and Preparative TLC.	**02**
3.3	**Paper chromatography-** • Introduction	**01**

	• Methodology • Development techniques (Ascending, Descending, Radial and Two-dimensional): **(Self-study-0.5 hr)** • Spray reagents • Advantages and disadvantages • **Applications: Self-study-0.5 hr**	
3.4	**Electrophoresis–**Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications	**03**
3.5	**HPTLC:** • Instrumentation- Applicator, photodensitometry, photodocumentation • **Advantages of HPTLC over TLC and HPLC (Self-study-0.5 hr)**	**01**
4	**Unit 4**	**08**
4.1	**Gas chromatography** – • Introduction • Theory • Instrumentation: Carrier gas supply, Sample injection system including Head space analysis, Columns (Packed, Open tubular columns, Capillary columns) and column ovens, Detectors (Thermal conductivity, Electron capture, Flame ionization) • Derivatization • Temperature programming • Advantages, disadvantages, and applications **(Self-study-0.5 hr)**	**04**
4.2	**High performance liquid chromatography (HPLC)-** • Introduction • Theory • Instrumentation: Mobile phase reservoir, Pumps (reciprocating, displacement, pneumatic) (Self-study-0.5 hr), Sample injection systems (Rheodyne injector and autosampler), Column types (analytical, guard and preparative columns) and column packing (porous, pellicular and monolithic), Detectors (Concept of solute and bulk property detector-Refractive index, UV-Vis, Phototodiode array, fluorescence, Electrochemical, Evaporative Light Scattering), Difference between UPLC and HPLC • Advantages, disadvantages, and applications **Self-study-0.5 hr)**	**04**
5	**UNIT 5**	**03**
5.1	**Ion exchange chromatography-** Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications	**01**
5.2	**Gel chromatography-** Introduction, theory, instrumentation, and applications	**01**
5.3	**Affinity chromatography-** Introduction, theory, instrumentation, and	**01**

	applications	
	Total Hours	**45**

Recommended Books (Latest Editions)

1. D. A. Skoog, F. J. Holler and S. R. Crouch, Principles of Instrumental Analysis, Saunders College Publishing, USA.
2. K. A. Connors, A Textbook of Pharmaceutical Analysis, John Wiley and Sons, Canada.
3. H. Beckett and J. B. Stenlake, Practical Pharmaceutical Chemistry, Part I and II, CBS Publishers and Distributors, India.
4. D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, Saunders College Publishing, USA.
5. G. D. Christian, Analytical Chemistry, John Wiley & Sons, Singapore, reprint by Wiley India Pvt. Ltd.
6. H. H. Willard, L. L. Merrit and J. A. Dean, Instrumental Method of Analysis, CBS Publishers and Distributors, New Delhi.
7. Ashutosh Kar, Pharmaceutical Drug Analysis, New Age International (P) Ltd. Publishers, India.
8. S. S. Mahajan, Instrumental Methods of Analysis, Popular Prakashan Pvt Ltd., India. G.R. Chatwal and S. K. Anand, Instrumental methods of chemical analysis, Revised and enlarged, Himalaya Publishing House Pvt. Ltd.
9. Indian Pharmacopoeia, The Indian Pharmacopeia Commission, Ghaziabad, Government of India, Latest Edition.
10. United States Pharmacopoeia, Latest Edition

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Course code	Course Name	Credits
BP702T	**Industrial Pharmacy II – Theory**	**4**

- **Pre-requisites**
  - Basic knowledge of Pharmaceutics and formulation development.

- **Course Outcomes: After the completion of the course, the learner will be able to:**
  1. Know the process of pilot plant and scale-up of pharmaceutical. dosage forms
  2. Understand the process of technology transfer from lab scale to commercial batch.
  3. Know different Laws and Acts that regulate pharmaceutical industry.
  4. Understand the approval process and regulatory requirements for drug products.

Sr. No.	Content	Hours
1	**Unit 1: Pilot plant scale-up techniques**	**10**
1.1	General considerations - including significance of personnel requirements, space requirements, raw materials	**03**
1.2	Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, Calculations for scale-up	**04**
1.3	SUPAC guidelines: SUPAC -IR guidelines in levels of changes – mild, moderate and major, Types of changes – change in composition, change in manufacturing process & manufacturing equipment and site changes and documentation required. Impact on regulatory aspects of changes	**02**
1.4	Introduction to Platform technology	**01**
2	**Unit 2: Technology development and transfer**	**10**
2.1	Terminologies, Technology transfer protocol, Quality risk management Transfer from R & D to production (Process, packaging and cleaning) Safety and hazard, Pre TT-Readiness	**04**
2.2	Granularity of TT Process (API, excipients, finished products, packing materials) Documentation, analytical method transfer. **Self-Study:** Premises and equipment, qualification and validation, quality control,	**02**
2.3	Approved regulatory bodies and agencies. Commercialization - practical aspects and problems (case studies)	**02**
2.4	TOT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI. Technology of Transfer (TOT) related documentation - confidentiality agreements, licensing, MoUs, legal issues	**02**
3	**Unit 3**	**10**
3.1	Regulatory Affairs: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities,	**02**

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	Role of Regulatory Affairs Department, Responsibility of Regulatory Affairs Professionals	
3.2	Regulatory requirements for drug approval: Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology	**03**
3.3	General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New 8 137 Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols	**03**
3.4	Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies	**02**
4	**Unit 4: Quality Management System**	**05**
4.1	Quality management & Certifications: Concept, Six Sigma concept, Out of Specifications (OOS), Change control, Quality by design. **Self-Study:** Total Quality Management, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP	**05**
5	**Unit 5**	**06**
5.1	Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Common Technical Document (CTD), Certificate of Pharmaceutical Product (COPP) Regulatory requirements and approval procedures for New Drugs	**06**
6	**Unit 6: Packaging Materials Science:**	**04**
6.1	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	**04**
	Total Hours	**45**

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' Second Edition.
4. Regulatory Affairs brought by learning plus, inc. available at http.//www.cgmp.com/ra.htm.

Recommended Weblinks

1. https://www.iptsalipur.org/wp-content/uploads/2020/08/BP702T_IP_II.pdf

Course Code	Course Name	Credits
BP703T	**Pharmacy Practice - Theory**	**4**

- **Prerequisites:**
  - Basic knowledge about drug dispensing, categories of drugs and labeling requirements.

- **Course Outcomes: After completion of this course students should be able to:**
  1. Understand the management of hospital pharmacy, community pharmacy, clinical pharmacy, and the functions of pharmacy and therapeutics committee.
  2. Comprehend adverse drug reaction classification, therapeutic drug monitoring, drug store management, and inventory control.
  3. Summarize the over-the-counter medications, investigational use of drugs, and interpretation of clinical laboratory tests.
  4. Show comprehensive understanding of the drug distribution systems, prescribed medication orders, and communication skills during practical situations.
  5. Gain the competence in Clinical Pharmacy and Drug Store Management and propose strategies to enhance medication adherence, improve patient counseling, and effectively implement educational programs within hospital settings.

Sr. No.	Content	Hours
1	**Unit 1**	**10**
1.1	**Hospital and its organization** Definition, Classification of a 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	**02**
1.2	**Hospital pharmacy and its organization** Definition, functions of hospital pharmacy, Organization structure, Location, Layout, and staff requirements, and Responsibilities and functions of hospital pharmacists.	**02**
1.3	**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, Brief on MedDRA and International Classification of Diseases	**03**
1.4	**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	**03**

2	**Unit 2:**	**10**
2.1	**Drug distribution system in a hospital.** Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labeling, dispensing of drugs to ambulatory patients, and dispensing of controlled drugs.	**02**
2.2	**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.	**02**
2.3	**Therapeutic drug monitoring** Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring.	**02**
2.4	**Medication adherence** Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence, Self medication and its impact.	**01**
2.5	**Patient medication history** interview Need for the patient medication history interview, and medication interview forms.	**01**
2.6	**Community pharmacy** management Financial, materials, staff, and infrastructure requirements	**01**
2.7	**Principles of forensic pharmacology**	**01**
3	**Unit 3**	**10**
3.1	**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.	**02**
3.2	**Drug information services.** Drug and Poison information center, Sources of drug information, Computerized services, and storage and retrieval of information.	**01**
3.3	**Patient counselling** Definition of patient counselling; steps involved in patient counselling, and Special cases that require the pharmacist.	**02**
3.4	**Education and training program in the hospital**	**02**
3.5	**Prescribed medication order and communication skills** Prescribed medication order- interpretation and legal requirements, and Communication skills communication with prescribers and patients Telepharmacy" and "virtual consultations	**03**
3.6	**Insurance systems in hospitals (self-study)**	
4	**Unit 4**	**08**
4.1	**Budget preparation and implementation Budget** preparation and implementation	**02**
4.2	**Clinical Pharmacy**	**05**

	Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review Introduction to Essential Drugs Monitor (EDM), Rational Use of Drugs (RUD) concept	
4.3	**Over the counter (OTC) sales** Introduction and sale of over-the-counter, and Rational use of common over-the-counter medications	**01**
5	**Unit 5**	**07**
5.1	**Drug store management and inventory control.** Organization of drug stores, 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. **Community Pharmacy Visit**	**05**
5.2	**Investigational use of drugs** Description, principles involved, classification, control, identification, role of a hospital pharmacist, advisory committee	**2**
5.3	**Interpretation of Clinical Laboratory Tests** (Haematology. Urine analysis) (Self-study)	
	Total Hours	**45**

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, 1sted. Chennai: Orient Longman Private Limited; 2004.
3. William E. Hassan. Hospital pharmacy, 5th ed. Philadelphia: Lea & Febiger; 1986.
4. Tipnis Bajaj. Hospital Pharmacy, 1st ed. Maharashtra: Career Publications; 2008.
5. Scott LT. Basic skills in interpreting laboratory data, 4th ed. American Society of Health System Pharmacists Inc; 2009.

Recommended Articles/ Journals:

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

Course code	Course Name	Credits
BP704T	**Novel Drug Delivery Systems – Theory**	**4**

- **Pre-requisites**
  - Basic knowledge of pharmaceutical formulations and their development and strong basis of Physical Pharmacy and biopharmaceutics.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Understand various approaches for development of novel drug delivery systems.
  2. Understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation.

Sr. No.	Content	Hours
1	**Unit 1**	**10**
1.1	**Controlled drug delivery systems:** Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. relevant to controlled release formulations	**03**
1.2	Approaches to design-controlled release formulations based on diffusion, dissolution, and ion exchange principles.	**02**
1.3	Physicochemical and biological properties of drugs relevant to controlled release formulations	**02**
1.4	**Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems	**03**
2	**Unit 2**	**10**
2.1	**Microencapsulation:** Definition, advantages and disadvantages, microspheres/microcapsules, microparticles, methods of microencapsulation, applications	**03**
2.2	**Mucosal Drug Delivery system:** Introduction, Principles of bioadhesion /mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems	**04**
2.3	**Implantable Drug Delivery Systems:** Introduction, advantages and disadvantages, concept of implants. Osmotic pump: Principal, Components, Design of elementary osmotic pump, Controlled Porosity, Bursting, Push pull osmotic pump, Alzet, OROS	**03**
3	**Unit 3**	**10**
3.1	**Transdermal Drug Delivery Systems:** Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches, microneedles	**03**
3.2	**Gastroretentive drug delivery systems:** Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high-density systems,	**03**

	inflatable and gastroadhesive systems and their applications	
3.3	**Nasopulmonary drug delivery system:** Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers	**04**
4	**Unit 4: Nanotechnology and its Concepts**	**08**
4.1	**Nanotechnology and its Concepts:** Concepts and approaches for targeted drug delivery systems, advantages and disadvantages,	**01**
4.2	Liposomes and applications	**02**
4.3	Niosomes and applications	**02**
4.4	Nanoparticles and applications	**02**
4.5	Monoclonal antibodies and applications	**01**
5	**Unit 5**	**07**
5.1	**Ocular Drug Delivery Systems:** Introduction, intra ocular barriers and methods to overcome –Preliminary study	**01**
5.2	Ocular formulations (Erodible and Non-Erodible Ocular Inserts) and ocuserts	**04**
5.3	**Intrauterine Drug Delivery Systems:** Introduction, advantages and disadvantages, development of intra uterine devices (Copper IUD,s, Hormonal IUD'S)	**02**
	Total Hours	**45**

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. Encyclopaedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim
4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
5. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

Recommended 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)

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Course code	Course Name	Credits
BP705P	**Instrumental methods of Analysis - Practical**	**2**

- **Pre-requisites**
  - Basic metric conversions
  - Concept of dilution factor

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Read, interpret, and execute spectroscopic and chromatographic analytical procedures and perform calculations thereof to draw inferences on the performed procedures
  2. Perform experiments for the selection of solvent system for TLC and paper chromatography separations of binary mixtures
  3. Identify components of various analytical instruments like spectrophotometers, HPLC system and handle and calibrate such instruments using the relevant SOPs
  4. Plan, execute and conclude the experiment using qualitative or quantitative techniques

Sr. No.	Content
1.	Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds
2.	Estimation of dextrose by colorimetry **(Demonstration)**
3	Estimation of sulfanilamide by colorimetry
4	Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy using simultaneous equation method and absorbance ratio method
5	Assay of paracetamol by UV- Spectrophotometry: a. Using standard absorptivity value (For tablets) b. Using difference spectroscopy (Using drug solution) c. Using calibration curve (Using drug solution)
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 **(Demonstration)**
10	Determination of chlorides and sulphates by nephelo turbidometry
11	Separation of amino acids by paper chromatography
12	a. Development and optimization of solvent system for separation of aspirin and salicyclic acid by TLC b. 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
16	Demonstration experiment on gel electrophoresis
17	Prepare a protocol for UV-Visible spectroscopic assay of drugs from bulk and formulation including selection of wavelength, solvent, formulae for calculation, and reporting of result

Recommended Books (Latest Editions)

1. A.H. Beckett and J.B. Stenlake, Practical Pharmaceutical Chemistry, 4th Edn., Part I and II, CBS Publishers and Distributors, India.
2. G. D. Christian, Analytical Chemistry, 6th Edn., John Wiley & Sons, Singapore, reprint by Wiley India Pvt. Ltd.
3. Indian Pharmacopoeia, The Indian Pharmacopeia Commission, Ghaziabad, Government of India.
4. United States Pharmacopeia.
5. J. Mendham, R. C. Denney, J. D. Barnes, M.J. K. Thomas, Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education Ltd.
6. D.G. Watson, Pharmaceutical Analysis –A textbook for pharmacy students and pharmaceutical chemists. 3rd Edn., Churchill Livingstone Elsevier.
7. L. R. Snyder, J. J. Kirkland, J. L. Glajch, Practical HPLC Method Development, 2nd Edn., Wiley-Interscience publication, John Wiley & Sons, Inc., Canada.
8. S. Ahuja and M. W. Dong, Handbook of Pharmaceutical Analysis by HPLC, Volume of Separation Science and Technology, Elsevier Academic Press, Indian edition.

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Course code	Course Name	Credits
BP706PS	**Practice School**	**6**

Every candidate shall undergo practice school for a period of 150 hours evenly distributed throughout the semester. The student shall opt any one of the domains for practice school declared by the program committee from time to time. At the end of the practice school, every student shall submit a printed report (in triplicate) on the practice school he/she attended (not more than 25 pages). Along with the exams of semester VII, the report submitted by the student, knowledge and skills acquired by the student through practice school shall be evaluated by the subject experts at college level and grade point shall be awarded.

Under each domain learner will undergo domain specific practical training, sets of new experiments, instrument/ equipment handling which is complemented by case studies and guest lectures from industry professionals. The learner will also undergo a field-based exposure through industry visits.

Sr. No.	Content	Hours
Unit 1:	**Common Modules**	**30**
Unit 2:	**Specific Domains (Any one):**	**120**
Sr. No.	**Subtopic**	
2.1	Formulation Development	
2.2	Pharmacology and Toxicology	
2.3	Drug Design and Process Chemistry	
2.4	Quality Control and Quality Assurance	
2.5	Herbal Drug Technology	

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Course code	Course Name	Credits
AEC_BP_701	Scientific Writing	-

- **Prerequisites**
  - Proficiency in basic writing skills, including grammar, punctuation, and sentence structure.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Develop the ability to effectively communicate scientific research related findings in a precise and systematic manner.
  2. Read relevant primary and secondary literature carefully and offer constructive criticism.
  3. Understand the iterative process of improving scientific writing skills with the help of the feedback received.
  4. Use the knowledge gained to also effectively write other academic documents like grant proposals and thesis.

Sr. No.	Content	Hours
1	**UNIT 1: Know the language (Basic English course)**	**07**
1.1	English in academic writing: Grammar and Sentence Structure, Vocabulary building, Paragraph Development	03
1.2	Argument matrix How to set the background of your article	01
1.3	Technical Writing Style, Common Writing Errors, Reading Comprehension	03
2	**UNIT 2: Understanding the Structure of Scientific Papers**	**09**
2.1	Title and Abstract, Introduction, How to set the background of your article and write rationale and objective(s), Methods, Results and discussion	04
2.2	References: Properly citing sources and following citation styles (e.g., APA, MLA) in the reference list. Referencing tools including AI tools	02
2.3	Designing effective tables, figures, graphical abstracts, graphs	03
3	**UNIT 3: Publication ethics and Plagiarism**	**02**
3.1	Introduction; Tools for the detection of plagiarism; Avoiding plagiarism	02
4	**UNIT 4: Scientific Publication Process**	**06**
4.1	Choosing the Right Journal, Authorship and Collaboration, Revision and Resubmission, Peer Review Process and Responding to peer review	03
4.2	Promoting Research Visibility: Techniques for increasing the visibility and impact of published research, including social media promotion, academic networking.	03
5	**UNIT 5: Drafting of other scientific documents**	**02**
5.1	Writing research **grant** proposal, Book review, thesis writing, career in scientific Writing	02

6	**UNIT 6: Experiential learning**	**04**
6.1	Case studies and presentations	04
	Total Hours	**30**

Recommended Books (Latest Editions)

1. Trisha Greenhalgh. How to read a paper. https://www.bmj.com/about-bmj/resources-readers/publications/how-read-paper
2. Guidance on Scientific Writing- Equator Network. https://www.equator-network.org/library/guidance-on-scientific-writing/
3. Kotz D, Cals J. Scientific writing and publishing in medicine and health sciences: A quick guide in English and German. Berlin, Boston: De Gruyter; 2021.

Recommended Weblinks

1. https://www.elsevier.com/en-in/connect/11-steps-to-structuring-a-science-paper-editors-will-take-seriously
2. https://researcheracademy.elsevier.com/

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Semester VIII

Course code	Course Name	Credits
BP801T	**Biostatistics and Research Methodology**	**4**

- **Prerequisites**
  - Importance of research
  - Basic mathematical operations, Basic Excel use, Logarithms, use of scientific calculator
  - Terminologies like mean, median, mode, standard deviation

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Identify and define key terms in research, research designs, optimization tools, and biostatistics, and select the appropriate descriptive and inferential statistical procedures based on the research question, design, and data type
  2. Solve descriptive statistics and inferential statistics problems if provided with sample data
  3. Enlist available statistics software and programming languages, remember the salient features of each and use Excel and R to perform simple descriptive and inferential statistical procedures if provided with sample data
  4. Describe the various research designs and optimization techniques such as CRD, RBD, Factorial design, CCD and RSM
  5. Write a scientific report and present the same using graphic illustrations, tabulated data in power point presentation

Sr. No.	Content	Hours
1	**UNIT 1**	**10**
1.1	**Introduction:** • Statistics, Biostatistics, Frequency distribution • Variables and their types, types of data, scales of measurement of variables	**02**
1.2	**Measures of central tendency**: Mean, Median, Mode- Pharmaceutical examples	**03**
1.3	**Measures of dispersion**: Dispersion, Range, standard deviation, pharmaceutical problems	**02**
1.4	**Correlation**: Definition, Karl Pearson's coefficient of correlation, Multiple correlation -Pharmaceuticals examples	**03**
2	**UNIT 2**	**10**
2.1	**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	**03**
2.2	**Probability:** Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties – problems, Sample, Population, large sample, small sample, Null hypothesis, alternative	**04**

	hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples	
2.3	**Parametric test**: t-test (Sample, Pooled or Unpaired and Paired), ANOVA, (One way and Two way), Least Significance difference	**03**
3	**UNIT 3**	**10**
3.1	**Non-Parametric tests:** Wilcoxon Sign Rank test, Mann-Whitney U test, Kruskal-Wallistest, Friedman Test, Chi square test	**02**
3.2	• **Introduction to Research:** Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism • **Open Access Publishing:** Open Access Publications and initiatives, SHERPA/ RoMEO online resource to check publisher copyright & self-achieving policies, Software tools to identify predatory publications developed by SPPU, Journal finder/ journal suggestion tools viz., JANE, Elsevier Journal Finder, Springer Journal, Suggester etc.	**03**
3.3	**Graphs:** Histogram, Pie Chart, Cubic Graph, response surface plot, Contour Plot graph	**02**
3.4	**Designing the methodology:** Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases.	**03**
4	**UNIT 4**	**08**
4.1	Blocking and confounding system for Two-level factorials	**02**
4.2	**Regression modelling:** Hypothesis testing in Simple and Multiple regression models	**02**
4.3	**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	**04**
5	**UNIT 5**	**07**
5.1	**Design and Analysis of experiment- Factorial Design:** Definition, 2^2, 2^3design. Advantage of factorial design	**03**
5.2	**Response Surface methodology**: Central composite design, Historical design, Optimization Techniques	**04**
	TOTAL	**45**

Recommended Books (Latest Editions)

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork.
2. Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha
3. Design and Analysis of Experiments –PHI Learning Private Limited, R. Pannerselvam,

4. Design and Analysis of Experiments – Wiley Students Edition, Douglas, and C. Montgomery

Course Code	Course Name	Credits
BP802T	**Social and Preventive Pharmacy - Theory**	**4**

- **Prerequisites**
  - Students should possess knowledge about the following:
    - Definition of Health
    - Different types of infectious disease and measures to prevent spread of diseases
    - Basic concepts of pathophysiology and Pharmacology.

- **Course Outcomes: After completion of this course students should be able to:**
  1. Explain the basic concepts related to health, diseases and health education and apply the knowledge for promoting health and hygiene at the social level.
  2. Explain the various measures to control and prevent spread of diseases and apply these principles to avoid spread of the disease.
  3. Understand the different types of national health programs and their objectives and apply this knowledge to create awareness among those socially connected with the learner.
  4. Understand the importance of community services and render them for societal benefit through analysis of social health problems and contribute to public health objectives.

Sr. No.	Content	Hours
1	**Unit 1: Concept of Health**	**10**
1.1	**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.	**02**
1.2	**Social and health education:** Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention	**02**
1.3	**Sociology and health:** Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health. **Survey in society for correlation of health and socio-cultural factors or interview of ASHA worker.**	**05**
1.4	**Hygiene and health:** personal hygiene and health care; avoidable habits	**01**
2	**Unit 2: Preventive Medicine**	**10**
2.1	**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 (self-study)**, COVID-19, diabetes mellitus, cancer, drug addiction-drug substance abuse	**10**
3	**Unit 3: National Health Programs, Objectives and functioning**	**10**
3.1	**National health programs, its objectives, functioning and outcome of the following:** HIV AND AIDS control programme, TB, National leprosy	**06**

	control programme, Universal immunization programme, Pulse polio programme	
3.2	**Objectives, functioning and outcome of the following:** Integrated disease surveillance program (IDSP), National mental health program, National programme for prevention and control of deafness, National programme for control of blindness.	**04**
4	**Unit 4: National Health intervention programs**	**08**
4.1	National health intervention programme for mother and child, National family welfare programme, National programme for the health care for the elderly, social health programme. **Visit to Government Maternity Home for understanding services provided under National health intervention programme for mother and child**	**05**
4.2	National tobacco control programme, National Malaria Prevention Program, role of WHO in Indian national program	**03**
5	**Unit 5: Community services**	**07**
5.1	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. Introduction to the International Pharmaceutical Federation (FIP) development goals **Visit to Government school for understanding Mid-day Meal Programme**	**07**
	Total Hours	**45**

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, ISBN14:9788190128285, Banarsidas Bhanot Publishers.
6. Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad

Recommended Articles: Research in Social and Administrative Pharmacy, Elsevier, Ireland

Recommended Website:

1. National Aids Control Organization Website: http://naco.gov.in/nacp

2. Ministry Of Health & Family Welfare, Directorate General Of Health Services Website: https://dghs.gov.in/content/1358_3_RevisedNationalTuberculosisControlProgramme.aspx
3. Integrated disease surveillance program Website: https://www.idsp.mohfw.gov.in/
4. National leprosy control programme: https://dghs.gov.in/content/1349_3_NationalLeprosyEradicationProgramme.aspx
5. National mental health program: https://main.mohfw.gov.in/Major-Programmes/non-communicable-diseases-injury-trauma/National-Mental-Health-Programme-NMHP
6. National programme for prevention and control of deafness: https://dghs.gov.in/content/1362_3_NationalProgrammePreventionControl.aspx#:~:text=National%20Programme%20for%20Prevention%20and%20Control%20of%20Deafness%20(NPPCD)%20was,a%20phased%20manner%20till%20now.
7. Universal immunization programme (UIP): https://nhm.gov.in/index1.php?lang=1&level=2&sublinkid=824&lid=220#:~:text=Universal%20Immunization%20Programme%20(UIP)%20is,preventable%20under%2D5%20mortality%20rate
8. National programme for control of blindness (NPCB): https://npcbvi.mohfw.gov.in/
9. Pulse polio programme: https://www.nhp.gov.in/pulse-polio-programme_pg, https://main.mohfw.gov.in/sites/default/files/brief_note.pdf
10. National health intervention programme for mother and child: https://nhm.gov.in/index1.php?lang=1&level=2&sublinkid=822&lid=218#:~:text=Pradhan%20Mantri%20Surakshit%20Matritva%20Abhiyan,on%209th%20of%20every%20month.
11. National family welfare programme: https://nhm.gov.in/index1.php?lang=1&level=2&sublinkid=821&lid=222
12. National tobacco control programme: https://nhm.gov.in/index1.php?lang=1&level=2&sublinkid=1052&lid=607#:~:text=Government%20of%20India%20launched%20the,ensure%20effective%20implementation%20of%20the
13. National Malaria Prevention Program: https://dghs.gov.in/content/1364_3_NationalVectorBorneDiseaseControlProgramme.aspx#:~:text=History%20of%20Malaria%20Control%20in%20India&text=To%20combat%20devastating%20effects%20of,cases%3B%20and%20treatment%20of%20patients.
14. National programme for the health care for the elderly: https://www.nhp.gov.in/national-program-of-health-care-for-the-elderly-n_pg
15. Social health programme: https://www.nhp.gov.in/social-health_pg
16. Role of WHO in Indian national program: https://www.who.int/india/our-work#:~:text=The%20World%20Health%20Organization%20is,monitoring%20and%20assessing%20health%20trends.

Course code	Course Name	Credits
BP803ET	Pharma Marketing Management -Theory (Elective)	4

- **Pre-requisites**
  - Knowledge of basic medical terminologies

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. State the importance of marketing in the pharma industry. Develop an understanding of Indian Pharma industry as well as Global Pharma market.
  2. Formulate marketing strategies with respect to pharmaceutical products. Able to formulate a pricing strategy.
  3. Take crucial product related decisions in the business world and create promotion and advertising strategies for pharmaceutical products.
  4. Gain a deeper understanding about pharmaceutical supply chain and logistics through different channels.
  5. Understand the role and responsibilities of Medical Representatives and Product Management team.

Sr. No.	Content	Hours
1	**Unit 1: Marketing & Pharmaceutical Market**	10
1.1	**Marketing:** Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analysing consumer buying behaviour; industrial buying behaviour	05
1.2	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. *Group-Case Studies Based on the topic: Success Story of the Top Pharmaceutical Brands	05
2	**Unit 2: Product decision**	10
2.1	Meaning, 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. *Create a product and sell it. This will involve all the steps of marketing, starting from manufacture to selling. Make a group presentation of the same.	10
3	**Unit 3: Promotion**	10

3.1	Meaning and 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. *Visit any exhibition (preferably Pharma related) and make a report on the Displays and Interactions	**10**
4	**Unit 4: Pharmaceutical marketing channels & Professional sales representative (PSR)**	**10**
4.1	**Pharmaceutical marketing channels:** Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.	**05**
4.2	**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 Changing profile of PSR, Modern Communication tools, Ethics in promotion Role Plays based learning of Various situations for a PSR in a Doctor's Chamber may be conducted.	**05**
5	**Unit 5: Pricing and Emerging concepts in marketing**	**10**
5.1	**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). Graded Group Presentations on Topics related to Market Pricing Strategies, Competitor pricing analysis may be conducted.	**05**
5.2	Emerging concepts in marketing: Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing. OTC Vs Rx Marketing	**05**
	Total Hours	**45**
***Activity based topics**		

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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

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Course code	Course Name	Credits
BP804ET	**Pharmaceutical Regulatory Science- Theory (Elective)**	**4**

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Know about the process of drug discovery and development
  2. Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
  3. Know the regulatory approval process and their registration in Indian and international markets

Sr. No.	Content	Hours
1	**UNIT 1**	**10**
1.1	**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.	
2	**UNIT 2**	**10**
2.1	**Regulatory Approval Process** Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA) in US. Changes to an approved NDA / ANDA.	**6**
2.2	**Regulatory authorities and agencies** Overview of regulatory authorities of United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)	**4**
3	**UNIT 3**	**10**
3.1	**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	
4	**UNIT 4**	**8**
4.1	**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	
5	**UNIT 5**	**7**
5.1	**Regulatory Concepts** Basic terminologies, guidance, guidelines, regulations, laws and acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book	
	Total Hours	**45**

Recommended books (Latest edition):

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

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Course code	Course Name	Credits
BP805ET	**Pharmacovigilance – Theory (Elective)**	**4**

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

Sr. No.	Content	Hours
1	**UNIT 1**	**10**
1.1	**Introduction to Pharmacovigilance** • History and development of Pharmacovigilance • Importance of safety monitoring of Medicine • WHO international drug monitoring programme • Pharmacovigilance Program of India(PvPI) • Introduction to Ecopharmacovigilance	**04**
1.2	**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	**04**
1.3	**Basic terminologies used in pharmacovigilance** • Terminologies of adverse medication related events • Regulatory terminologies	**02**
2	**UNIT 2**	**10**
2.1	**Drug and disease classification** • Anatomical, therapeutic and chemical classification of drugs • International classification of diseases • Daily defined doses	**03**

	• International Non proprietary Names for drugs	
2.2	**Drug dictionaries and coding in pharmacovigilance** • WHO adverse reaction terminologies • MedDRA and Standardised MedDRA queries • WHO drug dictionary • Eudravigilance medicinal product dictionary	**03**
2.3	**Information resources in pharmacovigilance** • Basic drug information resources • Specialised resources for ADRs	**02**
2.4	**Establishing pharmacovigilance programme** • Establishing in a hospital • Establishment & operation of drug safety department in industry • Contract Research Organisations (CROs) • Establishing a national programme	**02**
3	**UNIT 3**	**10**
3.1	**Vaccine safety surveillance** • Vaccine Pharmacovigilance • Vaccination failure • Adverse events following immunization	**03**
3.2	**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	**05**
3.3	**Communication in pharmacovigilance** • Effective communication in Pharmacovigilance • Communication in Drug Safety Crisis management • Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media	**02**
4	**UNIT 4**	**08**
4.1	**Statistical methods for evaluating medication safety data Safety data generation** • Preclinical phase • Clinical phase • Post approval phase	**03**
4.2	**ICH Guidelines for Pharmacovigilance** • Organization and objectives of ICH • Expedited reporting • Individual case safety reports	**05**

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	• Periodic safety update reports • Post approval expedited reporting • Pharmacovigilance planning • Good clinical practice in pharmacovigilance studies	
5	**Unit 5**	**07**
5.1	**Pharmacogenomics of adverse drug reactions** Genetics related ADR with example focusing PK parameters	**03**
5.2	**Drug safety evaluation in special population** • Paediatrics • Pregnancy and lactation • Geriatrics	**02**
5.3	**CIOMS** • CIOMS Working Groups • CIOMS Form	**01**
5.4	**CDSCO (India) and Pharmacovigilance** • D&C Act and Schedule Y • Differences in Indian and global pharmacovigilance requirements	**01**
	Total Hours	**45**

Recommended Books (Latest edition):

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 Pharmacoepidemiolog 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

Recommended weblinks

1. http://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn3=7297
2. http://www.ich.org/
3. http://www.cioms.ch/
4. http://cdsco.nic.in/
5. http://www.who.int/vaccine_safety/en/

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6. http://www.ipc.gov.in/PvPI/pv_home.html

Course code	Course Name	Credits
BP806ET	**Quality Control and Standardization of Herbals – Theory (Elective)**	**4**

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Know WHO guidelines for quality control of herbal drugs
  2. Know Quality assurance in herbal drug industry
  3. Know the regulatory approval process and their registration in Indian and international markets
  4. Appreciate EU and ICH guidelines for quality control of herbal drugs

Sr. No.	Content	Hours
1	**UNIT 1**	**10**
1.1	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	
2	**UNIT 2**	**10**
2.1	**Quality assurance in herbal drug industry** of cGMP, GAP, GMP and GLP intraditional system of medicine	**06**
2.2	WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants.	**04**
3	**UNIT 3**	**10**
3.1	EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines	
4	**UNIT 4**	**08**
4.1	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.	
5	**UNIT 5**	**07**
5.1	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	
	Total Hours	**45**

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 edn. World Health Organization, Geneva, 1981.
10. WHO. Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999.
11. WHO. WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005.
12. WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004

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Course code	Course Name	Credits
BP807ET	**Computer Aided Drug Design – Theory (Elective)**	**4**

- **Prerequisites**
  - Basics of Protein 3D structure, computer applications
  - Basics of organic chemistry related to bond characteristics interaction and reactivity
  - Medicinal Chemistry, Pharmacognosy, Analytical Techniques

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Recognize various stages and approaches of drug discovery and development
  2. Interpret the QSAR equation and 3D contour plots
  3. Design new molecules using molecular docking, de novo drug design, pharmacophore, and virtual screening techniques
  4. Debate on the use of informatics and databases in drug design
  5. Explain Molecular and Quantum Mechanics methods in drug design

Sr. No.	Contents	Hours
1	**Unit 1: Introduction to Drug Discovery and Development**	**10**
1.1	Stages of drug discovery and development	**02**
1.2	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	**04**
1.3	Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Any three case studies	**04**
2	**Unit 2: Molecular Modeling**	**07**
2.1	Introduction to molecular mechanics and quantum mechanics.	**04**
2.2	Energy Minimization methods and Conformational Analysis, global conformational minima determination.	**03**
3	**Unit 3: Quantitative Structure-Activity Relationship (QSAR)**	**10**
3.1	SAR versus QSAR, History and development of QSAR,	**02**
3.2	Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Taft's steric constant.	**02**
3.3	Hansch analysis, Free Wilson analysis	**03**
3.4	3D-QSAR approaches like COMFA and COMSIA.	**03**
4	**Unit 4: Molecular Modeling and virtual screening techniques**	**10**
4.1	Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening. De novo drug design.	**05**
4.2	Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening,	**05**

5	**Unit 5: Informatics & Methods in Drug Design**	**08**
5.1	Introduction to Bioinformatics,	**02**
5.2	chemoinformatics. ADME,	**03**
5.3	databases, chemical biochemical, and pharmaceutical databases.	**03**
	Total Hours	**45**

Recommended Books: (Latest Editions)

1. Delgado JN, Remers WA eds "Wilson & Gisvolds's Text Book of Organic
2. Medicinal & Pharmaceutical Chemistry" Lippincott, New York.
3. Foye WO "Principles of Medicinal chemistry 'Lea & Febiger.
4. Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" JohnWiley& Sons, New York.
5. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
6. Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston.
7. Silverman R.B. "The organic Chemistry of Drug Design and Drug Action"Academic Press New York. XYZ

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Course code	Course Name	Credits
BP808ET	**Cell and Molecular Biology – Theory (Elective)**	**4**

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Summarize cell and molecular biology history.
  2. Summarize cellular functioning and composition.
  3. Describe the chemical foundations of cell biology.
  4. Summarize the DNA properties of cell biology.
  5. Describe protein structure and function.
  6. Describe cellular membrane structure and function.
  7. Describe basic molecular genetic mechanisms.
  8. Summarize the Cell Cycle

Sr. No.	Content	Hours
1	**UNIT 1**	**10**
	a) Cell and Molecular Biology: Definitions theory and basics and Applications. b) Cell and Molecular Biology: History and Summation. c) Theory of the Cell? Properties of cells and cell membrane. d) Prokaryotic versus Eukaryotic e) Cellular Reproduction f) Chemical Foundations – an Introduction and Reactions (Types)	
2	**UNIT 2**	**10**
	a) DNA and the Flow of Molecular Structure b) DNA Functioning c) DNA and RNA d) Types of RNA e) Transcription and Translation	
3	**UNIT 3**	**10**
	a) Proteins: Defined **and** Amino Acids b) Protein Structure c) Regularities in Protein Pathways d) Cellular Processes e) Positive Control and significance of Protein Synthesis	
4	**UNIT 4**	**8**
	a) Science of Genetics b) Transgenics and Genomic Analysis c) Cell Cycle analysis d) Mitosis and Meiosis e) Cellular Activities and Checkpoints	
5	**UNIT 5**	**7**
	a) Cell Signals: Introduction b) Receptors for Cell Signals	

	c) Signaling Pathways: Overview d) Misregulation of Signaling Pathways e) Protein-Kinases: Functioning	
	Total Hours	**45**

Recommended Books (latest edition):

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

R. A Goldshy et. al.,: Kuby Immunology

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Course code	Course Name	Credits
BP809ET	**Cosmetic Science – Theory (Elective)**	**4**

- **Pre-requisites**
  - Foundational knowledge in pharmaceutical science and formulation aspects.

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Discuss the various raw materials for cosmetics and structure and function of human skin.
  2. Understand the toxicological aspects and toxicity testing for cosmetics and cosmeceuticals.
  3. Discuss the various cosmetics products w.r.t. raw materials, large scale manufacturing and functional and physicochemical evaluation including Herbal cosmetics.
  4. Know the regulatory guidelines and sensorial assessment for cosmetics.

Sr. No.	Content	Hours
1	**Unit 1**	**10**
1.1	Classification of cosmetic and cosmeceutical products Definition of cosmetics as per Indian and EU regulations, Evolution of cosmoceuticals from cosmetics, cosmetics as quasi and OTC drugs	**02**
1.2	Cosmetic excipients: Surfactants, rheology modifiers, humectants, emollients, preservatives. Hair: Basic structure of hair. Classification and application Hair growth cycle Oral Cavity: Common problem associated with teeth and gums. **Self-Study**: Basic structure and function of skin.	**08**
2	**Unit 2**	**10**
2.1	Principles of formulation and building blocks of skin care products: Face wash, Moisturizing cream, Cold Cream, Vanishing cream their relative skin sensory, advantages and disadvantages. Application of these products in formulation of cosmeceuticals. Vesicular skin care product	**03**
2.2	Principles of formulation and building blocks of Hair care products: Conditioning shampoo, Hair conditioners, antidandruff shampoo, Hair oils. Chemistry and formulation of Para-phenylene diamine-based hair dye.	**04**
2.3	Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash	**03**
3	**Unit 3**	**10**
3.1	Sun protection, Classification of Sunscreens and SPF	**02**
3.2	Role of herbs in cosmetics: Skin Care: Aloe and turmeric	**04**

	Hair care: Henna and amla. Oral care: Neem and clove	
3.3	Analytical cosmetics: BIS specification and analytical methods for shampoo, skin-cream and toothpaste	**04**
4	**Unit 4**	**08**
4.1	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.	**08**
5	**Unit 5**	**07**
5.1	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 odour. Antiperspirants and Deodorants- Actives and mechanism of action	**07**
	Total Hours	**45**

Recommended Books (Latest Editions)

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

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Course code	Course Name	Credits
BP810ET	**Experimental Pharmacology – Theory (Elective)**	**4**

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Appreciate the applications of various commonly used laboratory animals.
  2. Appreciate and demonstrate the various screening methods used in preclinical research
  3. Appreciate and demonstrate the importance of biostatistics and research methodology
  4. Design and execute a research hypothesis independently

Sr. No.	Content	Hours
1	**UNIT 1**	**08**
1.1	**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	
2	**UNIT 2**	**13**
2.1	**Preclinical screening models** • Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. • **Study of screening animal models for** o Diuretics, nootropics, anti-Parkinson's,antiasthmatics,	**06**
2.2	**Preclinical screening models:** for CNS activity- analgesic,antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease	**07**
3	**UNIT 3**	**12**
3.1	**Preclinical screening models:** for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics	
4	**UNIT 4**	**12**
4.1	**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.	**06**
4.2	**Research methodology and Bio-statistics** Selection of research topic, review of literature, research hypothesis and	**06**

	study design Pre-clinical data analysis and interpretation using Student's 't' test and One-way ANOVA. Graphical representation of data	
	Total Hours	**45**

Recommended Books (latest edition):

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

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Course code	Course Name	Credits
BP811T	Advanced Instrumentation Techniques – Theory (Elective)	4

- **Pre-requisites**
  - Carbocation stability, fission and rearrangements.
  - Difference between protons, neutrons and electrons
  - Liquid-liquid extraction- Partition coefficient, molecular diffusion, mass transfer

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Recall with examples the terminologies associated with spectroscopy, X-ray diffraction, extraction, immunoassays, calibration and validation
  2. Explain and illustrate the theory, instrumentation and applications of Nuclear Magnetic Resonance spectroscopy, mass spectrometry, thermal methods of analysis, X ray diffraction methods, radioimmunoassay, extraction and hyphenated techniques and the methodology of calibration and validation of analytical instruments
  3. Read and interpret simple NMR spectra to determine number of signals, chemical shifts of these signals, peak multiplicity, coupling constants and peak integration. Further, use this information to predict likely structural features of the molecules
  4. Read and interpret simple Mass Spectra generated using different ion sources to determine number of signals, likely molecular ion peak, likely isotope ion peaks, likely daughter ions. Further, use this information to predict likely structural features of the molecules
  5. Given spectral data (UV, IR, NMR), analyze and determine the likely molecular structure, and conversely, given a molecular structure, predict and interpret the mass spectrum/fragmentation in mass spectrometry

Sr. No.	Content	Hours
1	**Unit 1: Nuclear Magnetic Resonance spectroscopy & Mass spectrometry**	**10**
1.1	**Nuclear Magnetic Resonance spectroscopy** • **Principles of H-NMR and C-NMR**: ^{1}H-NMR phenomenon-spinning nucleus, precessional motion, precessional frequency, gyromagnetic ratio, energy transitions and relaxation processes, NMR Spectra • **Chemical shift, factors affecting chemical shift** • Solvents, Reference compounds and internal standards • **Coupling constant, Spin - spin coupling, relaxation:** N+1 rule (Pascal's triangle), theory of spin-spin splitting, formation of doublet, triplet, and quartet due to possible spin orientations, inverted tree diagram, Coupling constants & values for alkyl, alkenyl, aromatic) • **Instrumentation**: Instrumentation of NMR Spectrometer (including schematic representation) (Self-study-0.5 hr) • Principle of FT NMR	**06**

	(including representation of conversion of time domain spectra to frequency domain spectra) • **Applications**: Information obtained from proton NMR-Chemical shift, splitting, coupling constant, integration	
1.2	**Mass spectrometry** • **Principles**: Mass spectrum, relative abundance, mass to charge ratio, molecular ion, fragment ion (daughter ion), metastable ion, base peak, isotope peak, mass to charge ratio • **Instrumentation**: Basic components of mass spectrometer (including block diagram). Ionisation methods: Electron Ionisation, Chemical Ionisation - Electron impact, chemical ionization, MALDI, FAB Analysers: Quadrupole, Ion Trap and Time of Flight • **Fragmentation**: Examples of different mass fragmentation pathways • **Applications**	**04**
2	**Unit 2: Thermal Methods of Analysis & X ray Diffraction Methods**	**08**
2.1	**Thermal Methods of Analysis:** • Principles, instrumentation, and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) • Factors affecting the above thermal methods of analysis	**04**
2.2	**X-Ray Diffraction Methods:** • **Fundamentals-** Origin of X-ray, Bragg's law and its mathematical derivation, Bravais lattices and Miller indices • **Instrumentation & working principle**: X-Ray source (X-ray tube source) X-ray monochromator and detector • **Basic aspects of crystals**, Xray Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction • **Applications**: Crystal structure determination, polymorphism	**04**
3	**Unit 3: Calibration & Validation**	**07**
3.1	**Calibration and validation-**as per ICH and USFDA guidelines	**02**
3.2	**Calibration of following Instruments-** Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, HPLC **Self-study: Calibration of Fluorimeter, Flame Photometer and GC (1 hr)**	**05**
4	**Unit 4: Radioimmunoassay & Extraction techniques**	**08**
4.1	**Radioimmunoassay:** Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay	**03**
4.2	**Extraction techniques:** General principle and procedure involved in the solid phase extraction and liquid-liquid extraction	**05**

	Application: Assay of soluble aspirin tablets, Assay of sulphamethoxazole	
5	**UNIT 5: Hyphenated techniques**	**04**
	Hyphenated techniques-LC-MS/MS, GC-MS/MS, HPTLC-MS.	**04**
6	**Structure Elucidation by spectral techniques using UV, IR, 1H-NMR and Mass spectrometry**	**08**
6.1	UV-Woodward Fieser rules for predicting λ_{max} (acyclic & cyclic dienes, and α, β unsaturated ketones (acyclic and 6 membered ring). (Note-only alkyl substituents to be studied)	**02**
6.2	Elucidation of structure of a compound using IR and ^{1}H NMR data-Problems for simple organic compounds with molecular formula given	**03**
6.3	Mass spectrometry: Fragmentation: Representation of fragmentation process, Basic types of fragmentation: Fissions (homolytic and heterolytic, α and β fission). Rearrangement (Mclafferty, Retro Diel-Alders, 4 membered cyclic rearrangement), Nitrogen rule and Even electron rule	**03**
	Total	**45**

Recommended Books (Latest Editions)

1. D. A. Skoog, F. J. Holler and S. R. Crouch, Principles of Instrumental Analysis, Saunders College Publishing, USA.
2. K. A. Connors, A Textbook of Pharmaceutical Analysis, John Wiley and Sons, Canada.
3. A. H. Beckett and J. B. Stenlake, Practical Pharmaceutical Chemistry, Vol. 6, Part I and II, CBS Publishers and Distributors, India.
4. D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, Saunders College Publishing, USA.
5. G. D. Christian, Analytical Chemistry, John Wiley & Sons, Singapore, reprint by Wiley India Pvt. Ltd.
6. H.H. Willard, L. L. Merrit and J. A. Dean, Instrumental Method of Analysis, CBS Publishers & Distributors, New Delhi.
7. Ashutosh. Kar, Pharmaceutical Drug Analysis, New Age International (P) Ltd. Publishers, India.
8. S. S. Mahajan, Instrumental Methods of Analysis, Popular Prakashan Pvt Ltd., India.
9. G. R. Chatwal and S. K. Anand, Instrumental methods of chemical analysis, Himalaya Publishing House Pvt. Ltd.
10. Indian Pharmacopoeia, The Indian Pharmacopoeia Commission, Ghaziabad, Government of India. Latest Edition
11. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas, Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education Ltd.
12. D. G. Watson, Pharmaceutical Analysis –A textbook for pharmacy students and pharmaceutical chemists. Churchill Livingstone Elsevier.
13. J. W. Robinson, E. M. S. Frame and G. M. Frame II, Undergraduate Instrumental Analysis, Marcel Dekker, New York, USA.

14. R. Kellnar, J. M. Mermet, M. Otto, M. Valcarceland, H. M. Widmer, Analytical Chemistry: A modern approach to analytical science, Wiley-VCH, USA.
15. J. W. Munson, Pharmaceutical Analysis: Modern methods (in two parts), Marcel Dekker Inc., USA.
16. W. Kemp, Organic Spectroscopy, Palgrave Publishers Ltd., New York, USA.
17. R. M. Silverstein, F. X. Webster and D. J. Kiemle, Spectrometric identification of organic compounds, John Wiley & Sons, Inc. (Indian edition), New Delhi.
18. D. B. Troy and P. Beringer, Remington-The Science and Practice of Pharmacy, Vol-I & II, Wolters Kluwer/ Lippincott Williams & Wilkins (Indian edition), New Delhi.
19. J. W. Robinson, E. M. S. Frame and G. M. Frame II, Undergraduate Instrumental Analysis, Marcel Dekker, New York, USA.
20. J. R. Dyer, Applications Of Absorption Spectroscopy Of Organic Compounds, Prentice-Hall of India Pvt Ltd, New Delhi, India.
21. D. L. Pavia, G. M. Lampman, G. S. Kriz and J. R. Vyvyan, Introduction to Spectroscopy, Brooks/Cole Cengage Learning, Australia.
22. Y. R. Sharma, Elementary organic spectroscopy-Principles and Chemical Applications, S. Chand & Company Ltd, New Delhi, India.

Recommended Website: www.ich.org

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Course code	Course Name	Credits
BP812ET	Dietary Supplements And Nutraceuticals – Theory (Elective)	4

- **Pre-requisites:** Basic principles of Pharmacognosy

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Explain concept of nutraceuticals, dietary supplements, functional foods, classify these based on chemical nature, health benefits and mechanism of action
  2. Acquire the knowledge of chemistry of phytochemicals as nutraceuticals, their health benefits, recommended doses along with the marketed formulations
  3. To understand the effect of processing, storage and interactions of different environmental factors on the potential of nutraceuticals.
  4. To understand the role of antioxidants as nutraceuticals for prevention of various chronic diseases
  5. Describe the regulatory aspects for manufacture and sale of nutraceutical products and dietary supplements

Sr. No.	Content	Hours
1	**UNIT I**	10
	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. Micro and macro nutritional deficiency c) Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefitsof following used as nutraceuticals/functional foods: *Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds.*	
2	**UNIT –II**	10
	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.	
3	**UNIT –III**	10

	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..	
4	**UNIT –IV**	**8**
	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	
5	**UNIT-V**	**7**
	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. Introduction to Ayurvedic Formulary and Unani Formulary	

References:

1. Dietetics by Sri Lakshmi
2. Role of dietary fibres and neutraceuticals in preventing diseases by K.T Agusti and
3. P.Faizal: BSPunblication.
4. Advanced Nutritional Therapies by Cooper. K.A., (1996).
5. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988).
6. Prescription for Nutritional Healing by James F.Balch and Phyllis A.Balch 2 nd Edn.,
7. Avery Publishing Group, NY (1997).
8. G. Gibson and C.williams Editors 2000 Functional foods Woodhead Publ.Co.London.
9. Goldberg, I. Functional Foods. 1994. Chapman and Hall, New York.
10. Labuza, T.P. 2000 Functional Foods and Dietary Supplements: Safety, Good
11. Manufacturing Practice (GMPs) and Shelf Life Testing in Essentials of Functional
12. Foods M.K. Sachmidl and T.P. Labuza eds. Aspen Press.
13. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition)
14. Shils, ME, Olson, JA, Shike, M. 1994 Modern Nutrition in Health and Disease. Eighth edition. Lea and Febiger

Course code	Course Name	Credits
BP813ET	**Pharmaceutical Product Development -Theory**	**4**

Sr. No.	Content	Hours
1	**UNIT 1**	**10**
1.1	Introduction to pharmaceutical product development, objectives, regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms	
2	**UNIT 2**	**10**
2.1	An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Solvents and solubilizers ii. Cyclodextrins and their applications iii. Non - ionic surfactants and their applications iv. Polyethylene glycols and sorbitols v. Suspending and emulsifying agents vi. Semi solid excipients	
3	**UNIT 3**	**10**
3.1	An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Tablet and capsule excipients ii. Directly compressible vehicles iii. Coat materials iv. Excipients in parenteral and aerosols products v. Excipients for formulation of NDDS Selection and application of excipients in pharmaceutical formulations with specific industrial applications	
4	**UNIT 4**	**8**
	Optimization techniques in pharmaceutical product development.A study of various optimization techniques for pharmaceutical product development with specific examples.Optimization by factorial designs and their applications.A study of QbD and its application in pharmaceutical product development.	
5	**UNIT 5**	**7**
	Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations.	
	Total hours	**45**

Recommended Books (Latest editions)

1. Pharmaceutical Statistics Practical and Clinical Applications by Stanford Bolton, CharlesBon; Marcel Dekker Inc.
2. Encyclopedia of Pharmaceutical Technology, edited by James swarbrick, Third Edition,Informa Healthcare publishers.
3. Pharmaceutical Dosage Forms, Tablets, Volume II, edited by Herbert A. Lieberman andLeon Lachman; Marcel Dekker, Inc.
4. The Theory and Practice of Industrial Pharmacy, Fourth Edition, edited by Roop kKhar, S P Vyas, Farhan J Ahmad, Gaurav K Jain; CBS Publishers and Distributors Pvt.Ltd. 2013.
5. Martin's Physical Pharmacy and Pharmaceutical Sciences, Fifth Edition, edited by Patrick J. Sinko, BI Publications Pvt. Ltd.
6. Targeted and Controlled Drug Delivery, Novel Carrier Systems by S. P. Vyas and R. K.Khar, CBS Publishers and Distributors Pvt. Ltd, First Edition 2012.
7. Pharmaceutical Dosage Forms and Drug Delivery Systems, Loyd V. Allen Jr., Nicholas B.Popovich, Howard C. Ansel, 9th Ed. 40
8. Aulton's Pharmaceutics – The Design and Manufacture of Medicines, Michael E. Aulton,3rd Ed.
9. Remington – The Science and Practice of Pharmacy, 20th Ed.
10. Pharmaceutical Dosage Forms – Tablets Vol 1 to 3, A. Liberman, Leon Lachman andJoseph B. Schwartz
11. Pharmaceutical Dosage Forms – Disperse Systems Vol 1 to 3, H.A. Liberman, Martin, M.R and Gilbert S. Banker.
12. Pharmaceutical Dosage Forms – Parenteral Medication Vol 1 & 2, Kenneth E. Avis andH.A. Libermann.
13. Advanced Review Articles related to the topics.

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Course code	Course Name	Credits
BP814PW	**Project Work**	**6**

Project is a requirement for the B. Pharm. degree, wherein under the guidance of a faculty member, a group of not more than five learners in the eighth semester, is required to do some innovative work with the application of knowledge gained while learning various courses in the earlier years. The area of the project shall directly relate any one of the elective subjects opted by the student in semester VIII. The learner/s is/are expected to do a survey of literature in the subject, work out a Project plan and carry it out through survey, experimentation and/or modeling / computation. Through the Project work the learner has to exhibit skills for both analysis and critical thinking. The complete details of the project have to submitted as a report of not less than 25 pages (A4, 1-inch margins, single line space, font Times Roman, font size 12, excluding count of reference pages) to the College before the prescribed date. The credits assigned for Project is **6** credits.

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Course code	Course Name	Credits
VSC_BP_801_E	Entrepreneurship Management	-

- **Prerequisites**
  - Proficiency in communication skills, and motivation to explore entrepreneurship
- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Analyze various entrepreneurial opportunities and assess their viability using critical thinking skills.
  2. Develop innovative business ideas and formulate comprehensive business plans using creative thinking and problem-solving abilities.
  3. Assess the financial, legal, and ethical aspects of entrepreneurship to make informed decisions.

Sr. No.	Content	Hours
1	**UNIT 1: Conceptual Framework of Entrepreneurship**	**06**
1.1	Introduction to entrepreneurship	01
1.2	Role of entrepreneurship in national and global economies	01
1.3	Types of enterprises: merits and demerits	01
1.4	Government policies and schemes for enterprise development	01
1.5	Institutional support in enterprise development and management	02
2	**UNIT 2: UV-Visible Spectroscopy**	**06**
2.1	Dynamics of entrepreneurial motivation	01
2.2	Entrepreneurial competencies: self-awareness, interpersonal skills, creativity, assertiveness, achievement	02
2.3	Factors affecting the entrepreneur's role	03
3	**UNIT 3: Launching and Organizing an Enterprise**	**06**
3.1	Environment scanning: information sources and schemes of assistance	01
3.2	Enterprise selection and market assessment	01
33	Feasibility study and SWOT analysis	01
3.4	Resource mobilization: finance, technology, raw material, site, and manpower	01
3.5	Costing, marketing management, and quality control	01
3.6	Legal and Ethical steps towards enterprise	01
4	**UNIT 4: Growth Strategies and Networking**	**06**
4.1	Performance appraisal and assessment	01
4.2	Profitability and control measures	01
4.3	Diversification: need, techniques, and challenges	01
4.4	Future growth strategies: expansion, diversification, vision	02
4.5	Joint ventures, coordination, and feasibility studies	01
5	**UNIT 5: Application sand Case studies**	**06**
5.1	Feasibility report: planning, resource mobilization, implementation	01
5.2	Developing a project proposal for a new enterprise	01

5.3	Presentation skills for project proposals	02
5.4	Case Studies: Analysis of real-world entrepreneurial ventures. OR Group Discussions: Exploration of entrepreneurial challenges and opportunities. AND Assignments: Completion of feasibility studies, project proposals, and presentations.	02
	Total Hours	**30**

Recommended Books (Latest Editions)

1. Akhauri, M. M. P. (1990): Entrepreneurship for Women in India, NIESBUD, New Delhi.
2. Hisrich, R. D & Brush, C.G. (1996) The Women Entrepreneurs, D.C. Health& Co., Toranto.
3. Hisrich, R.D. and Peters, M.P. (1995): Entrepreneurship – Starting Developing and Managing a New Enterprise, Richard D., Inwin, INC, USA.
4. Meredith, G.G. etal (1982): Practice of Entrepreneurship, ILO, Geneva.
5. Patel, V.C. (1987): Women Entrepreneurship – Developing New Entrepreneurs, Ahmedabad EDII
6. Arya kumar. (2012): Entrepreneurship- Creating and Leading an Entrepreneurial Organization, Pearson

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Course code	Course Name	Credits
SEC_BP_801_E	Experimental Techniques in Biotechnology	-

- **Prerequisites**
  - Understanding of basic microbiology lab techniques this includes knowledge of cell structure, genetics, physiology, and general anatomy

- **Course Outcomes: After the completion of course, learner will be able to:**
  1. Perform experiments in Western Blotting, gel electrophoresis, and DNA isolation to achieve reliable results and advance scientific understanding.
  2. Explain good laboratory practices pertaining to the cell culture laboratory.
  3. Explain the design of the cell culture lab and the equipment required to set up such a lab with the functions and importance of each equipment.
  4. Perform Subculturing following aseptic techniques.

Sr. No.	Contents	Hours
1	**Unit 1**	10
1.1	Overview of Enzyme immobilization and Its applications Experiment on Immobilization of yeast cells	02
1.2	Instrumentation and application of Gel electrophoresis. Experimental techniques for Isolation of DNA and Separation by using Gel electrophoresis	04
1.3	Techniques and applications of Southern, Northern and western blotting Experimental technique of western Blotting	04
2	**Unit 2: Introduction to animal tissue culture**	20
2.1	**Essentials of cell culture, Safety aspects of cell culture,** Aseptic Technique and Good Cell Culture Practice	04
2.2	Media Preparation	04
2.3	Primary Cell Culture	04
2.4	Subculturing and Maintenance and Contamination Management	04
2.5	Cell Quantification	04
	Total Hours	30

Recommended Books (Latest Editions)

1. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten. (2010) Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press.
2. Daan J. A. Crommelin, Robert D. Sindelar. (2002) Pharmaceutical Biotechnology: An Introduction for Pharmacists and Pharmaceutical Scientists. Taylor & Francis.
3. Gary Stein and Maria B et al. (2011) Human Stem Cell Technology and Biology. Wiley Blackwell.
4. Gordana Vunjak-Novakovic, R. Ian Freshney. (2006) Culture of Cells for Tissue Engineering. John Wiley & Sons.
5. R. C. Dubey, A textbook of biotechnology

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6. B. D. Singh, Biotechnology.
7. S. P. Vyas and Dixit, Pharmaceutical Biotechnology, CBS publisher & distributers.

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