INSTITUTE OF CHEMICAL TECHNOLOGY
(Deemed to be University under section 3 of the UGC Act 1956)

DEPARTMENT OF PHARMACEUTICAL SCIENCES AND TECHNOLOGY

Degree of Bachelor of Pharmacy (B. Pharm) Syllabus

The Institute revamped the syllabi of various courses in 2009. All the courses are credit based and the evaluation are grade based. The credit system is a systematic way of describing an educational programme by attaching credits to its components. The definition of credits is based on student workload, learning outcomes and contact hours. It is a student-centric system based on the **student workload** required to achieve the objectives of a programme.Each theory course consists of Lectures and tutorials. During tutorial session it is expected that the problem solving / case studies / relevant real life applications / student presentations / home assignments / individual or group projects are discussed in presence of the teacher. Teacher can have the freedom to interchange lectures / tutorials depending upon the need. Each laboratory course consists of practical hours and/or extra lecture hours depending upon the need. The Institute gives emphasis on continuous evaluation with considerable freedom to the teacher in deciding the mode of evaluation of the students. It is desirable to revise the syllabi of various courses every 5-6 years. Accordingly, the B. Pharm syllabus is being revised. The revised syllabus comes into effect for first year Bachelor of Pharmacy students from the academic year 2015- 2016

There were several motivations for the syllabus revision:

- AICTE / NBA accreditation guidelines require
  - program objectives to be defined for the course
  - course objectives to be defined for each subject
  - map showing how the course objectives meet the program objectives
  - map showing the linkage between different courses

- The admission of B.Pharm students is based on MHCET.

- Feedback about the course contents as well as overall structure was taken from various experts (alumni as well as others), who are working in the areas of Pharmacy from industry and academic Institutions. These experts were from diverse backgrounds:Industry(R&D, production, Quality assurance, regulatory, IPR etc), Academics consultancy etc. Some of the salient points of the feedback are:

  - ICT students have excellent background in chemistry, industrial aptitude, core Pharmacysubjects.
  - Analytical abilities need to be further strengthened
  - Students need to be exposed to newer and emerging areas in Pharmacy and allied subjects, such as nanotechnology, biotechnology, green technology.
  - Students need to be exposed to social service
  - Syllabus needs to have more electives and flexibility for student to choose courses as per liking, electives can be grouped to form one area of expertise
  - Communication skills, Interpersonal skills, team work need to be strengthened
  - Knowledge in management related subjects need to be enhanced; e.g. finance, human resource, IP, etc.

Theweightages of different modes of assessments shall be as under.

	In-Semester evaluation			
	Continuous Assessment (C. A.)	OneMid Semester Examination (M. S.)	End-Semester Examination (E. S.)	Possible components of continuous assessment
Theory Subject	20%	30%	50%	Quizzes, online tests, class tests (open or closed book), home assignments, group assignments, viva-voce, group projects and assignments, etc.
Practicals	50%	-	50%	Attendance, *viva-voce*, journal, assignments, project, experiments, tests, etc.

Students' Evaluation:

(a) It is expected that the teacher would conduct at least two assessments as a part of continuous assessment in a Semester

(b)The teacher will announce at the beginning of the respective course the method of conducting the tests under the continuous assessment mode and the assignment of marks for various components of continuous assessment

(c) In-semester performance of all students should be displayed and sent to the academic office by the teacher at least 15 days before the end-semester examination.

(d) For the theory courses, two mid-semester tests for each course will be held as per the schedule fixed in the Academic Calendar.

(e)A mid-semester examination of 30 marks will be conducted for 2 hour duration. A mid semester examination of 15 marks will be conducted for 1 hours duration.

(f) The end semester examination will cover the full syllabus of the course and will be conducted as per the Institutional time table at the end of each semester.

(g) An end semester examination of 50 marks will be conducted for 3 hours duration. An end semester examination of 25 marks will be conducted for 2 hours duration.

Detailed discussions were conducted by the syllabus revision committee of the Department and the following Programme Education Objectives (PEO), Programme Outcomes (PO) and Graduate Attributes (GA) were decided. The syllabus revision was carried out in view of the following PEO, PO and GA:

Programme Education Objectives

1. Create awareness amongst students about the social/industrial demands and role of pharmacist in the society
2. Incorporate a culture of research and Innovation by providing students with latest facilities
3. Provide a platform to the students to interact with leading teachers, scientists and industry practitioners
4. Multi-faceted development of students through co-curricular and extra-curricular activities, participation in various events
5. Build technical and managerial capabilities amongst students to meet the needs of society and industry

Programme Outcome and Graduate Attributes:

1. Have knowledge of Pharmacy related subjects, allied subjects including biomedical, and administrative pharmacy related aspects.
2. Have Ability in planning and time management, implementation, organization, delegation and resource management.
3. Have analytical, logical and scientific ability to evaluate problems and arrive at effective decisions.
4. Be adept in the use of modern methods and appropriate tools and resources related to pharmacy with a good understanding of the same.
5. Have leadership skills, understanding human behavior, enable team building and provide motivation as important facets of development. Such development to be directed for the health and welfare of society through participation as responsible citizens.
6. Be pharmaceutical professionals who understand their role as educators and professionals for the promotion of healthcare in society
7. Be ethical professionals of the pharmacy profession who respect and honor personal values and follow ethical principles in professional and social life and assume responsibility for their actions.
8. Have effective communication skills both spoken and written. This would ensure appropriate communication with society at large, and the ability to present and write effective reports.
9. Be stake holders in contributing to national healthcare, imbibe sufficient knowledge to assess societal, health, safety and legal issues and the consequent responsibilities.
10. Appreciate the need and importance of environment protection and sustainable development and promote the same in the context of the pharmacy profession
11. Have the passion for lifelong learning and the ability to engage in the same independently and hence adapt readily to technological changes. Identify learning needs as a practice and work on them regularly through upgradation.

Grading system:

1. As a measure of students‟ performance the following letter grades and corresponding grade points per credit, shall be followed:

Grade	Grade points per credit
AA	10.0
AB	9.0
BB	8.0
BC	7.0
CC	6.5
CD	6.0
DD	5.5
EE	5.0
FF	0
I	0
T	0

Instructor of the course will submit the absolute marks obtained by the candidates (out of 50 or out of 100, as the case may be), in the following heads depending on whether the course is theory or laboratory: (i) Continuous Assessment, (ii) Final Examination, and (iii) Total Marks.

3. Depending on the grace marks (to be decided) by the Results Committee; the absolute marks obtained by the candidates under each subject head will be calculated. These absolute marks will be converted to grades and grade points for each subject for each candidate in the following manner:

a. Candidates who have failed (secured less than 40% of the marks even after considering grace marks) will be given grade „FF‟ for that subject.

b. Based on the absolute marks obtained by the successful (passed) candidates in a particular subject, „CLASS AVERAGE‟ will be calculated for each subject.

c. If „CLASS AVERAGE‟ is less than 65%, then the „CLASS AVERAGE‟ is given a grade „CC‟. AA, AB, BB, and BC grades are given between „CLASS AVERAGE‟ and „HIGHEST MARKS‟ based on equal increments. CD, DD, and EE grades are given between „CLASS AVERAGE‟ and the minimum passing marks based on equal increments (40%).

d. If „CLASS AVERAGE‟ is greater than 65%, but less than 70%, then the „CLASS AVERAGE‟ is given a grade „BC‟. AA, AB, and BB grades are given between „CLASS AVERAGE‟ and „HIGHEST MARKS‟ based on equal increments. CC, CD, DD, and EE grades are given between „CLASS AVERAGE‟ and the minimum passing based on equal increments (40%).

e. If „CLASS AVERAGE‟ is greater than 70%, then the „CLASS AVERAGE‟ is given a grade „BB‟. AA and AB grades are given between „CLASS AVERAGE‟ and „HIGHEST MARKS‟ based on equal increments. BC, CC, CD, DD, and EE grades are given between „CLASS AVERAGE‟ and the minimum passing based on equal increments (40%).

4. A semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$\text{SGPA} = \frac{\left(\sum_{i=1}^{n} c_i g_i\right)}{\left(\sum_{i=1}^{n} c_i\right)}$$

where,

„n‟ is the number of subjects for the semester,

„ci‟ is the number of credits allotted to a particular subject, and

„gi‟ is the grade points awarded to the student for the subject based on his performance as per the above table.

SGPA will be rounded off to the second place of decimal and recorded as such.

5. Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{\left(\sum_{i=1}^{m} c_i g_i \right)}{\left(\sum_{i=1}^{m} c_i \right)}$$

where,
„m" = total number of subjects from the first semester onwards up to and including the semester S,
„ci" = number of credits allotted to a particular subject, and
„gi" = grade points awarded to the student for the subject based on his performance as per the above table.
CGPA will be rounded off to the second place of decimal and recorded as such.
6. The CGPA would indicate the cumulative performance of the student from the first semester up to the end of the semester to which it refers.
7. The CGPA, SGPA and the grades obtained in all the subjects in a semester will be communicated to every student at the end of every semester / beginning of next semester.
8. Candidate will be considered to have passed the course if he / she secures grade „EE" or higher (AA, AB, BB, BC, CC, CD, DD).

Supplementary Examinations:
1. For those candidates who fail (Grade „FF") in one or more subjects, another examination called „Supplementary Examination" (50% weightage) will be held after one month of the declaration of the result for the particular semester.
2. The marks obtained by the candidate during the semester in the Continuous Assessment will be carried forward and added to the marks obtained in the Final Examination.
3. The total marks will be considered for award of grades and grade points. The grades are to be calculated based on the grading scheme discussed in point **No. 3** under the heading „**Grading System**". However, the maximum grade obtainable after such supplementary examination is **'ONE GRADE LESS'** than that obtained after the supplementary examination. If „EE" is obtained in the supplementary examination, then it remains „EE".

Grade the candidate would have got after Supplementary Examination	Grade actually given	Grade Point per Credit
AA	AB	9.0
AB	BB	8.0
BB	BC	7.0
BC	CC	6.5
CC	CD	6.0
CD	DD	5.5
DD	EE	5.0
EE	EE	5.0
FF	FF	0
I	I	0
T	T	0

When a student gets the grade „FF" or „I" in any subject during a semester, the SGPA and CGPA from that semester onwards will be tentatively calculated, taking only „zero point" for each such „FF" or „I" grade. After the „FF" grade(s) has / have been substituted by better grades after the supplementary examination or subsequent semesters, the SGPA and CGPA will be recomputed and recorded to take this change of grade into account.
5. The candidate can continue for the research project in semester III and IV with whatever grade obtained in the previous semesters. However, the candidate must clear all the courses where is has FF and/or I before getting the passing certificate.
6. The records of all candidates will have to be maintained in the Institute for the grade point average calculations.
7. A candidate who remains absent for the regular final examinations and supplementary examinations for **ALL SUBJECTS** will be considered to have dropped out / terminated from the course and will be given a grade „T".

PHARMACEUTICAL SCIENCES AND TECHNOLOGY

Syllabus structure B.Pharm First Year

Semester —I

Subject Code	Subjects	Credits	Hrs/Week			Marks			
			L	T	P	Continuous Assessment	Periodic Test	Final Exam	Total
CHT1101	Inorganic Chemistry	3	2	1	0	10	15	25	50
CHT1105	Organic Chemistry-I	3	2	1	0	10	15	25	50
PHT1112	Pharmaceutics-I	3	2	1	0	10	15	25	50
MAT1201	Mathematics & Statistics-I	3	2	1	0	10	15	25	50
CET1803	Pharmaceutical Engineering	4	3	1	0	20	30	50	100
HUT1102	Communication skills and psychology	3	2	1	0	10	15	25	50
CHP1101	Organic Chemistry Laboratory-I	2	0	0	4	25	-	25	50
CEP1801	Pharmaceutical Engineering Laboratory	2	0	0	4	25	-	25	50
	TOTAL	23	13	6	8				450

Semester — II

Subject Code	Subjects	Credits	Hrs/Week			Marks			
			L	T	P	Continuous Assessment	Periodic Test	Final Exam	Total
CHT1106	Organic Chemistry-II	3	2	1	0	10	15	25	50
PHT1103	Physical Chemistry and Physical Pharmacy	4	3	1	0	20	30	50	100
PHT1113	Pharmaceutics-II	3	2	1	0	10	15	25	50
PHT1207	Anatomy, Physiology & Pathology-I	4	3	1	0	20	30	50	100
PHT1304	Pharmaceutical Analysis-I	3	2	1	0	10	15	25	50
MAT1202	Mathematics & Statistics-II	3	2	1	0	10	15	25	50
PHP1111	Pharmaceutics Laboratory - I	2	0	0	4	25	-	25	50
PHP1103	Physical Pharmacy Laboratory-I	2	0	0	4	25	-	25	50
PHP1304	Pharmaceutical Analysis Laboratory-I	2	0	0	4	25	-	25	50
	TOTAL	26	14	6	12				550

Syllabus Structure B. Pharm Second Year

Semester — III

Subject Code	Subjects	Credits	Hrs/Week			Marks			
			L	T	P	Continuous Assessment	Periodic Test	Final Exam	Total
PHT1406	Pharmaceutical Organic Chemistry	3	2	1	0	10	15	25	50
PHT1114	Pharmaceutics-III	3	2	1	0	10	15	25	50
PHT1208	Anatomy, Physiology & Pathology-II	4	3	1	0	20	30	50	100
PHT1305	Pharmaceutical Analysis-II	3	2	1	0	10	15	25	50
BST1302	Biochemistry	4	3	1	0	20	30	50	100
HUT1103	Sociology and Ethics	3	2	1	0	10	15	25	50
PHP1112	Pharmaceutics Laboratory-II	2	0	0	4	25	-	25	50
PHP1204	Anatomy, Physiology & Pathology Laboratory	2	0	0	4	25	-	25	50
BSP1302	Biochemistry Laboratory	2	0	0	4	25	-	25	50
	TOTAL	26	14	6	12				550

Semester — IV

Subject Code	Subjects	Credits	Hrs/Week			Marks			
			L	T	P	Continuous Assessment	Periodic Test	Final Exam	Total
PHT1407	Pharmaceutical and Medicinal Chemistry –I	3	2	1	0	10	15	25	50
PHT1115	Dispensing and Hospital Pharmacy	3	2	1	0	10	15	25	50
PHT 1209	Pharmacology- I	3	2	1	0	10	15	25	50
PHT1306	Pharmaceutical Analysis-III	4	3	1	0	20	30	50	100
BST1202	Microbiology	3	2	1	0	10	15	25	50
CHP1102	Organic Chemistry Laboratory-II	2	0	0	4	25	-	25	50
PHP1113	Dispensing Pharmacy Laboratory	2	0	0	4	25	-	25	50
PHP1305	Pharmaceutical Analysis Laboratory-II	2	0	0	4	25	-	25	50
IPP1102	Computer Laboratory	2	0	0	4	25	-	25	50
	TOTAL	24	11	5	16				500

Syllabus Structure B.Pharm Third Year

Semester — V

Subject Code	Subjects	Credits	Hrs/Week			Marks			
			L	T	P	Continuous Assessment	Periodic Test	Final Exam	Total
PHT1408	Pharmaceutical & Medicinal Chemistry–II	3	2	1	0	10	15	25	50
PHT1116	Biopharmaceutics and Pharmacokinetics	3	2	1	0	10	15	25	50
PHT1117	Cosmeticology	3	2	1	0	10	15	25	50
PHT 1210	Pharmacology-II	3	2	1	0	10	15	25	50
BST1203	Molecular Biology & Biotechnology	3	2	1	0	10	15	25	50
PHT1118	Forensic Pharmacy and Drug store management	4	3	1	0	20	30	50	100
PHP1403	Pharmaceutical Chemistry Laboratory	2	0	0	4	25	-	25	50
PHP1114	Cosmeticology Laboratory	2	0	0	4	25	-	25	50
BSP1203	Microbiology & Biotechnology Laboratory	2	0	0	4	25	-	25	50
	TOTAL	25	13	6	12				500

Semester — VI

Subject Code	Subjects	Credits	Hrs/Week			Marks			
			L	T	P	Continuous Assessment	Periodic Test	Final Exam	Total
PHT1409	Pharmaceutical & Medicinal Chemistry – III	3	2	1	0	10	15	25	50
PHT1119	Pharmaceutics IV	3	2	1	0	10	15	25	50
PHT 1211	Pharmacology-III	3	2	1	0	10	15	25	50
PHT 1504	Pharmacognosy-I	3	2	1	0	10	15	25	50
HUT1106	Environmental Science and Technology	3	2	1	0	10	15	25	50
	Elective I	3	2	1	0	10	15	25	50
PHP1115	Pharmaceutics (including Biopharmaceutics) Laboratory- III	2	0	0	4	25	-	25	50
PHP1205	Pharmacology Laboratory-I	2	0	0	4	25	-	25	50
PHP1504	Pharmacognosy Laboratory-I	2	0	0	4	25	-	25	50
PHP1702	Seminar	2	0	0	4	-	-	50	50
	TOTAL	26	12	6	16				500

Syllabus Structure B.Pharm Final Year

Semester — VII

Subject Code	Subjects	Credits	Hrs/Week			Marks			
			L	T	P	Continuous Assessment	Periodic Test	Final Exam	Total
PHT1410	Pharmaceutical & Medicinal Chemistry – IV	3	2	1	0	10	15	25	50
PHT1120	Pharmaceutics- V	3	2	1	0	10	15	25	50
PHT 1212	Pharmacology-IV	3	2	1	0	10	15	25	50
PHT 1505	Pharmacognosy-II	3	2	1	0	10	15	25	50
	Elective II	3	2	1	0	10	15	25	50
HUT1202	Pharmaceutical Management	3	2	1	0	10	15	25	50
PHT 1213	Clinical Pharmacy and Drug Interactions	3	2	1	0	10	15	25	50
PHP1116	Pharmaceutics Laboratory IV	2	0	0	4	25	-	25	50
PHP1206	Pharmacology Laboratory-II	2	0	0	4	25	-	25	50
PHP1505	Pharmacognosy Laboratory-II	2	0	0	4	25	-	25	50
PHP1703	In plant training report and presentation and Community service	2	0	0	4	-	-	50	50
	TOTAL	29	14	7	16				550

Semester — VIII

Subject Code	Subjects	Credits	Hrs/Week			Marks			
			L	T	P	Continuous Assessment	Periodic Test	Final Exam	Total
PHT1411	Pharmaceutical and Medicinal Chemistry–V	3	2	1	0	10	15	25	50
PHT 1506	Pharmacognosy-III	3	2	1	0	10	15	25	50
PHT1602	Pharmaceutical Biotechnology	3	2	1	0	10	15	25	50
	Elective III	3	2	1	0	10	15	25	50
PHT1121	Pharmaceutics VI	3	2	1	0	10	15	25	50
PHP1404	Medicinal Chemistry Laboratory	2	0	0	4	25	-	25	50
PHP1117	Pharmaceutics Laboratory - V	2	0	0	4	25	-	25	50
PHP1506	Pharmacognosy Laboratory-III	2	0	0	4	25	-	25	50
PHP1704	Home Paper	3	0	0	6	-	-	150	150
	TOTAL	24	10	5	18				550

FIRST YEAR B.PHARM SEMESTER I

	Course Code: CHT1101	**Course Title: Inorganic Chemistry**	**Credits = 3**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	HSC Chemistry				
List of Courses where this course will be prerequisite					
	All pharmaceutical and medicinal chemistry courses				
Description of relevance of this course in the B. Pharm. Program					
To train the students with respect to basics of inorganic chemistry, co-ordination chemistry					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	Periodic Table, s,p,d and f elements and their general properties, correlations among various properties.`	3
2	Main group Chemistry: Hydrogen, Chemistry of Group IA, II B and Group IIIB to VIIB elements and noble gases.	10
3	Chemical Bonding: Valence Bond theory and Molecular orbital theory	3
4	Coordination Chemistry: Nomenclature, Werner theory, VSEPR, crystal field theory, electronic and magnetic properties of the complexes.	12
5	Organometallics: Metal Ligand concept, types of ligands, Effective atomic number rule reactions using organometallic compounds like addition, insertion, migration. Concepts of sigma bond and pi bond formation. Application of organometallic complexes in hydrogenation, hydroformylation, carbonylation etc.	11
6	**Radiopharmaceuticals**: Radio activity, Measurement of radioactivity, Properties of a, ß, γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances	6
List of Text Books/ Reference Books		
1	J. D. Lee, Concise Inorganic Chemistry, Oxford Blackwell Science, 5th edition 1996	
2	F. A. Cotton, G. Wilkinson and P. L. Guas, Basic Inorganic Chemistry, 3rd ed., John Wiley, 1994.	
3	J. E. Huheey, E. A. Kieter and R. L. Keiter, Inorganic Chemistry, 4th ed., Harper Collins, New York, 1993	
4	Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, 7th edition, ELBS/Longman, Londo, 1988	
5	J. H. Block, E. B. Roche, T. O. Soine, C. O. Wilson, Inorganic Medicinal and Pharmaceutical Chemistry, Varghese Publishing House, First Indian Reprint, 1986	
Course Outcomes (students will be able to…..)		
1	Know the arrangement of elements in the periodic table and the periodic properties.	
2	Understand the different kinds of chemical forces in molecules.	
3	Identify the nature of chemical bond in a given inorganic compound.	
4	Know the existence of special types of compounds through weak chemical forces.	

	Course Code: CHT1105	**Course Title: Organic Chemistry-I**	**Credits = 3**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	HSC Chemistry				
List of Courses where this course will be prerequisite					
	Organic Chemistry-II				
Description of relevance of this course in the B. Pharm. Program					
To train the students with respect to structural chemistry concepts, stereochemistry, aliphatic and aromatic reaction mechanisms					

Sr.	**Course Contents (Topics and subtopics)**	**Reqd. hours**

No.		
1	**Structural Chemistry Concepts**	9
	Electronegativity, Inductive effect, Dipole moment, Polarizability, Electron density , Formal charge, Electrostatic potential mapping (w.r.t C,N,O,S and their bonding)	
	Resonance in aliphatic and aromatic systems – rules of resonance, stability of the resonating structures	
	Tautomerism (types of tautomerism), hyperconjugation, curved arrow notations	
	Reactive intermediates: Electrophiles, Nucleophiles (charged and neutral species), carbocations, carbanions, carbenes and carbon radicals: Geometry, stability and properties. Concept of leaving groups, alkyl shift, migratory aptitude.	
2	**Three dimensional structure and stereochemistry**	8
	Stereoisomerism: Stereochemistry of compounds containing one and two carbon atoms, enantiomers and diastereoisomers, Geometric isomerism.	
	Classical representation of molecules by the use of projection formulae: Fischer, Wedge, Sawhorse and Newman. Drawing Structures and understanding 3D structures using Computer softwares	
	Nomenclature of stereo isomers including cis/trans, D/L, E/Z and R/S designations.	
3	**Structure-Property relationship**	7
	Functional groups and their properties wrt Acidity, Basicity, Lipophilicity, Hydrophilicity, Steric properties, Solubility, Ionization. Stability assessment guidelines and Property prediction for multiple functional groups	
4	**Chemistry of alkanes, alkenes and alkynes**	12
	Alkanes**:** Nomenclature, Physical properties, preparation of alkanes: Hydrolysis of Grignard reagent, reduction of alkyl halides by metal and acid,Corey House reaction, Wurtz reaction; Reactions: halogenation of alkanes (Mechanism and orientation).	
	Alkene: Nomenclature, Physical properties, Preparation of alkenes; Dehydrohalogenation of alkyl halides (mechanism and orientation of E1 and E2), dehydration of alcohols, dehalogenation of vicinal dihalides, conversion of aldehydes and ketones to alkenes (Wittig reaction, Peterson, Shapiro reaction). Reactions: Addition of H_2, Addition of HX, halogens in water, H_2SO_4, H_2O, free radicals, alkenes(dimerization), alkanes (alkylation), ozonolysis, Michael addition, Simmons-Smith reaction, epoxidation, halogenation by allylic substitution, hydroboration oxidation, oxymercuration–demercuration, oxidation using $KMnO_4$& OsO_4	
	Dienes: Resonance in conjugated dienes, electrophilic addition to conjugated dienes 1,2 and 1,4-additions, Diels Alder reaction	
	Alkynes: Nomenclature, Physical properties, acidity of terminal alkynes, formation of metal acetylides. Preparation of alkynes: dehydrohalogenation of alkyl halides, reaction of metal acetylides with primary alkyl halides; Addition reactions: Addition of HX, H_2O, Hydroboration oxidation, metal ammonia reductions, hydrogenation using Lindlar's catalyst.	
5	**Benzene and Aromaticity**	9
	Concept of aromaticity: Huckel's rule .identification of aromatic, non-aromatic and anti-aromatic systems based on planarity, conjugation and Huckel's rule.	
	Electrophilic Aromatic Substitutions: Reactions of benzene (with mechanism and structures of intermediates) – nitration, sulphonation, protonation, halogenation, Friedel-Crafts alkylation and acylation. Classification and influence of substituent groups on orientation and reactivity, orientation in disubstituted benzenes.	
	Nucleophilic Aromatic Substitution: Bimolecular displacement mechanism, reactivity and orientation in nucleophilic aromatic substitution, elimination–addition mechanism.	
List of Text Books/ Reference Books		
1	J. McMurry, Brooks/Cole, Organic Chemistry, 6th Ed. 2004	
2	T.W.G. Solomons, C.B. Fryhle, Organic Chemistry, John Wiley and Sons Inc., 10th Ed. 2009	
3	L.G. Wade Jr, Organic Chemistry, Pearson Education India, 2008	
4	E.L. Eliel, Stereochemistry of Carbon compounds, Mcgraw-Hill, 1962	
5	Paula Y. Bruice, Organic Chemistry, Pearson Education, 7th Ed. 2014	
6	Joseph E. Rice, Organic Chemistry concepts and applications for medicinal chemistry, Elsevier, 2014	
Course Outcomes (students will be able to…..)		
1	Know organic nomenclature	
2	Write simple mechanism	
3	Appreciate aliphatic chemistry	
4	Appreciate stereochemistry	

	Course Code:PHT1112	Course Title: Pharmaceutics I	Credits = 3		
			L	T	P
	Semester: I	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	HSC (Science)				
List of Courses where this course will be prerequisite					
	Pharmaceutics-II				
Description of relevance of this course in the B. Pharmacy					
To train the students with respect to basics of Pharmaceutics and in-depth knowledge of monophasic pharmaceutical products					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	History of Pharmacy, Development of profession of pharmacy& pharmaceutical industry in India.	2
2	Origin & Development of the pharmacopoeia – IP/BP/USP Introduction to monograph, parts of monograph	3
3	Introduction to dosage forms	3
4	Introduction to GMP and & routes of administration	5
5	Monophasic liquids : Preformulation considerations	4
6	Principles ofSolubilization and Taste masking	5
7	Formulation considerations in the development of solutions, syrups, linctuses monophasic liquid oral dosage form Formulation considerations in the development of gargles, mouthwashes, throat paints etc.	4 4
8	Formulation considerations in the development of monophasic liquid external dosage forms-lotions, liniments, collodions Formulation considerations in the development of monophasic liquid external dosage forms-douches, ear drops, nasal drops, enemas etc.	4 4
9	Large scale manufacture, facility design and equipments for Monophasics	3
10	Quality control of Monophasic liquid dosage forms	4

List of Text Books/ Reference Books	
1	Howard C. Ansel, Nicholas G. Popovich, Lord V. Alien, Pharmaceutical Dosage Form And Drug Delivery Systems, 10th edition, 1995, B.I.Waverly Pvt.Ltd.,New Delhi, 2013
2	Allen, Loyd V., Jr, Remington-The Science And Practice Of Pharmacy (Vol.1& 2), 22nd edition, Lippincott Williams &Wilkins, 2012
3	J.W. Cooper, Colin Gunn, Tutorial Pharmacy, 4th edition, Sir Isaac Pitman & Sons Ltd.,London, 1950
4	Michael E. Aulton, Pharmaceutics: The Science Of Dosage FormDesign, Churchill-Livingstone, 1988
5	J.W. Cooper, Colin Gunn,Tutorial Pharmacy, 4th edition, Sir Isaac Pitman & Sons Ltd., London, 1950
6	Alfred N.Martin,JamesSwarbrick,ArthurCammarata, Physical Pharmacy-Physical Chemical Principles In Pharmaceutical Sciences, 2nd edition, Lea &Febiger,Philadelphia, 1969
7	Roop K. Khar, S. P. Vyas, Farhad J. Ahmad, Gaurav K. Jain, The Theory and Practice of Industrial Pharmacy- 4th Edition, CRS press, 2013
8	Goseph. B. Sprowls, Prescription Pharmacy, 2nd edition, 1970
9	Bentley and E. A. Rawlins, Bentley's Textbook Of Pharmaceutics, 8thedition, 1977
10	Howard Ansel, Introduction Of Pharmaceutical DosageForms, 3rdedition, Lea &Febiger, 1981
11	Pharmacopoeias: Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia, all editions

Course Outcomes (students will be able to…..)	
1	Know pharmacopoeia
2	Understand principles of solubilization and taste masking
3	Detailed knowledge of monophasic pharmaceutical products for oral and external use w.r.t prefromulation, formulation, scale-up, packaging quality control
4	Appreciate importance of good manufacturing practices

	Course Code:MAT1201	Course Title: Mathematics & Statistics – I	Credits = 3		
			L	T	P
	Semester: I	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	HSC Mathematics				
List of Courses where this course will be prerequisite					
	Mathematics & Statistics – II, Biopharmaceutics and Pharmacokinetics, Biostatistics, Computer Laboratory				
Description of relevance of this course in the B.Pharm Program					
To train the students with respect to basics of mathematics and statistics and its application in Pharmaceutical Sciences					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	**Matrices and Determinants:** Types of matrices, transpose of a matrix, inverse of a matrix, determinant of a matrix and its properties, elementary row and column operations on matrices, rank of a matrix, solution of system of linear equations using Gauss elimination methods, inverse method and Cramer's rule	6
2	**Differential calculus:** Rolle's and Lagrange's mean value theorems, Successive derivatives, Leibnitz rule for nth derivative, Taylor's and Maclaurins series expansions. Functions of two/three and several variables, partial differentiation, Euler formula and its applications, Local and absolute maxima-minima and its applications to least square problems and curve fitting. Notion of improper integral, its convergence and applications to Gamma-Beta functions	12
3	**Integral calculus:** Properties of integrals, integration by parts, introduction to double and triple integrals	6
4	Numerical Solutions of non-linear equations using Newton-Raphson, Secant and Regula-Falsi Methods	3
5	Lagrange Interpolations formula, Newton's backward and forward interpolation formulae, Trapezoidal rule, Simpsons 1/3rdand 3/8th rules of integrations and its applications	6
6	Solution of 1st and second order ordinary differential equations and their applications to chemical reactions and biopharmaceutics (Rate constants, Order of reaction: first order reaction, second order reaction, pseudo-first order reactions, Arrhenius equation), Exponential decay (half life calculations, drug elimination), Noyes-whitney equation, Ficks law of diffusion, Hixson-Crowell model, Higuchi, peppas dissolution models	12

List of Text Books/ Reference Books		
1	Bali NP, Gupta PN, Gandhi CP, A Textbook of B.Pharmaceutical Mathematics (Remedial Mathematics Vol.I and Vol. II).	
2	Khan RA, Khan A, Pharmacy and Biotechnology Mathematic	
3	Brahmankar DM, Jaiswal SB, Biopharmaceutics and Pharmacokinetics	
4	Jain RK, Iyengar SRK, Advanced Engineering Mathematics, 3rd Edition, Naros, 2007	
5	Wartikar PN, Wartikar JN , Elements Of Applied Mathematics,6th Edition, Pune VidyarthiGraha, 1997	
6	Kreyszig E, Advanced Engineering Mathematics, 9th Edition, Wiley International, 2005	
7	Advanced Engineering Mathematics. Zill DG, Warren S. Wright, 4th Edition	
Course Outcomes (students will be able to…..)		
1	Appreciate the importance of mathematics and statistics with relevance to pharmaceutical sciences	
2	Understand relevant applications	

	Course Code: CET1803	Course Title: Pharmaceutical Engineering	Credits = 4		
			L	T	P
	Semester: I	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	Mathematics and Statistics, Physics				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the B. Pharm. Program					

To train the students with respect to basics of engineering and their application in unit operations which are required in pharmaceutical industries		
Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	Unit operations- Introduction, classification of unit operations, fundamental Principles	3
2	Fluid flow-mention of fluid properties such as viscosity, surface tension of fluid, and hydrostatic infusing fluidflow, Bernoulli's Theorem, flow of liquids in pipes, laminar and turbulent flow;	4
3	Heat transfer-mention of different modesofheat transfere.g.conduction, convection and radiation;	3
4	Mass transfer and molecular diffusion in liquids, mass transfer in turbulent and laminar flow, interfacial mass transfer; Refrigeration, air condition and humidification; hygrometry, humidification and dehumidification	5
5	Mixing : A) liquid-liquidmixing, B) Mixing small quantities of solids in liquids, C) Mixing large quantities of solids in liquids, perfect mixing and random mixing, degree of mixing, mechanismof mixingand demixing, rate of mixing, impellers and propeller mixers, baffles in tanks, trough mixers, mixers, sigma and ribbon blenders, paddle mixers, double cone blender, cube mixers, planetary mixers,	7
6	Emulsification and Homogenization: Process and equipment used and equipment selection for, including colloid mills, Silverson type homogenizer.	5
7	Filtration and clarification- factors influencing rate of filtration, filter media and filter aids, Nutsch filter, plate and frame filter, sparkler, leaf filters, rotary vacuum filters, sintered glass andmembrane filters-selection of filters, Filtration ofair, primary filters and HEPA filters and their evaluation	5
8	Centrifugation- objective and requirements – hydroextractors.	3
9	Fluidization: Particulate fluidization, aggregate fluidization-	3
10	Separation by mass transfer: Solid-liquid extraction and liquid extraction, equipmentandmethodsofoperation-distillation,batchfractionation,vacuum and still distillation, azeotropic and extractive distillation, fractional distillation and fractionating columns; Recovery of solvents.	6
11	Energy and mass transfers:Crystallisation-crystal shapes and habits, crystal growth,crystallization inmelts,nucleation,crystallization fromsolutions,rateof crystallisation, Energy effect in the process, size of crystal, different crystallisers, principles underlying the design and operations;	6
12	Theories of Absorption and adsorption, Absorption of gases in liquids, Adsorption of liquids on carriers	5
13	Drying: Fluid bed dryers, Microwave dryers, Freeze dryers, Spray dryers, tray dryer, tunnel dryer, turbo dryer	5
List of Text Books/ Reference Books		
1	Walter L. Badger, Julius T. Banchero, Introduction to Chemical Engineering International Student Edn. McGraw Hill Book Company	
2	Perry Robert H. Green Don W, Perry's Chemical Engineer's Handbook.7th edition, McGraw Hill, 1997	
3	J.W. Cooper, C. Gunn, Tutorial Pharmacy 4th edition, Sir Isaac Pitman, 1950	
4	A.R. Paradkar, Introduction To Pharmaceutical Engg. 6th edition, Nirali Prakashan, 2004	
Course Outcomes (students will be able to…..)		
1	Knowledge of unit operations, heat and mass transfer	
2	Able to understand the fundamentals of unit operations and fluid flows	
3	Able to understand the various operations in mixing with equipments	
4	Able to understand the liquid solid separation and their equipments	
5	Able to comprehend energy mass transfer in crystallization, dryers.	

	Course Code: HUT1102	**Course Title: Communication Skills and Psychology**	**Credits = 3**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Not applicable				
List of Courses where this course will be prerequisite					
	All courses				
Description of relevance of this course in the B. Pharm Program					
To enable students to communicate more effectively in written and spoken English					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
	Communication Skills & Personality Development:	
1	Basics of communication- Communication Cycle, Components of communication process, Verbal & Non verbal communication, Barriers to communication	5
2	Writing skills: Emails, letters, technical reports etc	5
3	Self development through presentations and group discussions	4
4	Effective audio visual presentation skill development	5
5	Building a self Image: Basic Etiquette to be followed, Appearance, Body Language	4
	Psychology NOTE: All relevant topics can be dealt with special reference to the Pharmaceutical Industry	
6	Definition of Psychology, sub fields of Psychology; Industrial Psychology: definition, nature and scope, history, premices, development, and hurdles;	7
7	Personnel Selection: occupational information, individual differences, personnelspecifications -its types. and objectives;Methods of job analysis; Uses of job analysis; Types of personnel actions: Selection techniques : Application blanks, reference, interview; Psychological Tests: Intelligence (Otis, Standford-Binet, Weehster adult Intelligence test, Multifactor tests) aptitude (DAT), personality (Rorschaeh, TAT and MMPI);	7
8	Personnel Development : Motivation – theories of motivation (Marlowe, Vroom)motivation and organization ; Incentives– financial and non-financial job satisfaction, Herberg's two factor theory, factors affecting satisfaction; Morale and Monotony; Definition and nature of Leadership, functions of leaders, trait theory ofleadership – Managerial grid, Field less Contingency Model; Accident Preventionand Safety Measures.	8
	List of Text Books/ Reference Books	
1	Elements of style – Strunk and white	
2	Industrial Psychology and sociology for B. Pharmacy students. Author is Prof. B.V. Pathak.	
3	Schermerhorn, Hunt, and Osborn, Organizational Behavior, Seventh Edition, Wiley, 2010	
4	Stephen .P. Robbins, Organisation Behaviour , Prentive-Hall,India	

	Course Code: CHP1101	**Course Title: Organic Chemistry Laboratory-I**	**Credits = 2**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 60**	**0**	**0**	**4**
	List of Prerequisite Courses				
	HSC Chemistry				
	List of Courses where this course will be prerequisite				
	All Pharmaceutical Chemistry and Medicinal Chemistry Courses				
	Description of relevance of this course in the B. Pharm. Program				
To train the students in standard laboratory practices with respect to safety, understand qualitative analysis of organic molecules					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Laboratory safety measures to be taken for: a. Fire and burns b. Spillage c. Inhalation of toxic fumes d. Dress code in a laboratory e. First aid measures to be taken in cases of accidents f. Use of fume hood, eye shower, body shower.	**4**
2	Techniques for Organic spotting: a. Melting point and boiling point determination b. elemental analysis c. Functional group detection d. Preparation of derivatives	 **4** **4** **8** **8**
3	Organic spotting of a) Mono functional groups (5 excercises) b) Bifunctional groups to be taken (3 excercises)	**5*4** **3*4**
	List of Text Books/ Reference Books	

1	Furniss, Brian S. Vogel's textbook of practical organic chemistry, Pearson Education India	
2	F.G. Mann and B.C. Saunders, Practical Organic Chemistry, 4th edition published by Orient Longman.	
3	Kulkarni V.S and Pathak S. P .A laboratory hand book of organic qualitative analysis and separation. D. Ramchandra & Co., INdia.	
4	Kulkarni V.S and Pathak S. P. Text book of organic practical chemistry, D. Ramchandra & Co., India	
Course Outcomes (students will be able to…..)		
1	Work safely in the organic chemistry laboratory	
2	Understand and implement techniques for organic spotting	
3	Identify mono and bifunctional organic compounds	

	Course Code: CEP1801	**Course Title: Pharmaceutical Engineering Laboratory**	**Credits = 2**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Mathematics and Statistics, Physics, Pharmaceutical Engineering				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the B. Pharm. Program					
To train the students in the fundamental of unit operations					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	Study of various parameters in recrystalization	15
2	Various types of distillations	15
3	Study of various parameters in solid liquid separations	10
4	Mass transfer and molecular diffusion in liquids, mass transfer in turbulent and laminar flow, interfacial mass transfer	10
5	Various types of mixings	10
List of Text Books/ Reference Books		
1	Sudhakara Reddy Pondugula, Pharmaceutical Engineering: Practical Manual (Unit Operations), Practical Handbook, 2007	
2	Sona, P. S., A Practical Mannual of Practical Manual of Pharmaceutical Engineering, Universal Sciences press, 2010	
Course Outcomes (students will be able to…..)		
1	Knowledge of unit operations, heat and mass transfer	
2	Knowledge of solid liquid separations	
3	Knowledge of mass heat transfer	

FIRST YEAR B.PHARM SEMESTER II

	Course Code: CHT1106	**Course Title: Organic Chemistry-II**	**Credits = 3**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Organic Chemistry I				
List of Courses where this course will be prerequisite					
	Organic Chemistry III				
Description of relevance of this course in the B. Pharm. Program					
To train the students with respect to stereochemistry and various functional groups chemistries					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**

1	**Aliphatic and aromatic halides**	6
	Nomenclature, Physical properties, Preparation: Hunsdieker reaction (other methods covered under reactions of other functional groups).Reactions: Nucleophilic aliphatic substitutions reactions – Mechanism, factors affecting $S_N1$and S_N2 reactions, S_Ni reaction.E1, E2 reactions(mechanism) Grignard reagent and applications. Haloarenes – Halogenation of arenes, important reactions including aromatic nucleophilic substitution reactions, elimination – addition and addition –elimination mechanisms	
2	**Alcohols**	4
	Nomenclature, Physical properties, preparation of alcohols using Grignard synthesis, Aldol condensation, reduction of acids, esters of carbonyl compounds, Wittig rearrangement.	
	Reactions: HX, PX_3, with metals, esterification, oxidation, Pinacol-Pinacolone rearrangement. Thiols.	
3	**Phenols**	5
	Nomenclature, Physical properties, preparation of phenols: hydrolysis of diazonium salts, from aryl sulphonates, haloarenes, alkylbenzenes, Acidity of phenols. Reactions: ester formation, electrophilic substitution reactions-nitration,sulphonation,o-alkylations,o-acylations,Friedle-Crafts alkylation,nitrosation,Fries rearrangement, Claisen rearrangement,Kolbe-Schimdt reaction, Reimmer-Tiemman reaction Schotten-Baumann reaction,Hauben Hoesch reaction, Lederer Manasse reaction.	
4	**Ethers , Epoxides and Thioethers**	3
	Nomenclature, Physical properties. Preparation – Williamson's synthesis,alkoxy mecuration-demercuration,industrial sources of ethers. Reaction with HX, Wittig rearrangement. Preparation of epoxides ,their reactions and applications.Thioethers	
5	**Amines**	5
	Nomenclature, Methods of preparation : From alkyl halides, reduction of nitro compounds with metal/HCl and Na_2S_2/NH_4S_6,reduction of amides, reduction of cyanides, reduction of oximes, reductive amination, Leukart method, Gabriel phthalimide method, Hofmann, Curtius, Lossen, Schmidt rearrangements with mechanism. Physical properties. Reactions of amines: with acid, with alkyl halides, conversion to amides, Schotten-Baumann technique, ring substitution in aromatic amines, Hoffmann elimination. Mechanism of Steven & Sommelet alkylations. Diazotization with mechanism and its application including Sandmeyer reaction mechanism, Gomberg reaction mechanism.	
6	**Aldehydes and ketones**	8
	Nomenclature, Methods of preparation: Dry distillation of anhydrides, oxidation of primary and secondary alcohol, oxidation of methylbenzene, reduction of acid chlorides, from reaction of acid chloride with organocopper. Gattermann, Gattermann –Kotch, Vilmeyer –Haack, Rosenmund and Friedel Craft acylation reactions. Oxidation with Ag $(NH_3)_2$, $KMnO_4$, $K_2Cr_2O_7$, $NaOH/I_2$, reduction with H_2/Pt or Ni or Pd, $LiAlH_4$, $NaBH_4$, Clemmensons and Wolf Kishner Reduction. Nucleophilic additions like cyanohydrins, acetal formation, Grignard, derivatives of ammonia, $NaHSO_3$, Organolithium compounds. Condensation with discussion of mechanism of Aldol(acid and base catalyzed),mixed Aldol, crossed Aldol, nitroaldol,retroaldol,Claisen-Schmidt,halogenation of ketones, Perkin, Benzoin condensation, Knovenagel,Dobener-Knovenagel, Reformatsky, Michael, Benzilic acid alkylation, Dakin oxidation,Benzoin condensation, Wittig, Wolff,Bayer-Villiger oxidation, Diazomethane reaction, Stobbes, Willgerodt, Favroskii, Canizzaro, MPV reduction, Tischenko reaction,Mannich reaction .	
7	**Carboxylic acids**	4
	Nomenclature, Methods of preparation: Oxidation of alcohols, oxidation of alkylbenzenes, from alkylation reagent, hydrolysis of nitriles, malonic ester synthesis of carboxylic acid with alkylation. Acidity and factors affecting acidity.	
	Reactions with base, with $SOCl_2$, PCl_3, PCl_5, SO_2Cl_2, with alcohol, conversion to amides, reduction, Hell-Volhard-Zelinsky reaction. Condensation reactions like Dieckmann condensation with mechanism.	
8	**Amides**	3
	Nomenclature, Methods of preparation of amides, imides	
	Reactions of amides: Hoffmann and Beckmann alkylations and its mechanism including transformations. Identification test like diazotization after acid hydrolysis.	
9	**Esters**	3
	Nomenclature, Method of preparation	
	Reactions: Basic and acidic hydrolysis of esters with mechanism, conversions to amides, transesterification, reaction with Grignard and organolithium, catalytic hydrogenation of esters, reduction with $LiAlH_4$, Claisen condensation, mixed Claisen, crossed Claisen.	
10	**Redox reactions**	4

	Applications of following reagents in organic synthesis: Mn and Cr based oxidizing agents, oxygen, hydrogen peroxide, per acids and peroxides, ozone, SeO_2, V_2O_5, lead tetraacetate, Oppenaur oxidations. Catalytic hydrogenation, Clemmenson reduction, hydrazine, borohydrides,LAH,$SnCl_2$,MPV reduction,S and Se, dissolving metal reductions, Na/alcohol, Na/Liq.NH_3, Na dithionate	
	Note: **All the functional groups should betaught with respect to problem solving approach**	
	List of Text Books/ Reference Books	
1	J. McMurry, Brooks/Cole, Organic Chemistry. 6th ed, 2003, Brooks/Cole	
2	T.W.G. Solomons, C.B. Fryhle, Organic Chemistry, 11th ed, .John Wiley and Sons Inc.	
3	L.G. Wade Jr, Organic Chemistry, 8th ed, 2012. Pearson Education	
4	Organic Chemistry, Schaum's outline series, 4th Ed. McGraw Hill	
5	Paula Y. Bruice, Organic Chemistry, 7th ed. Pearson Education	
	Course Outcomes (students will be able to…..)	
1	Know organic nomenclature	
2	Write simple mechanism	
3	Appreciate aliphatic chemistry	
4	Appreciate stereochemistry	

	Course Code: PHT1103	**Course Title: Physical Chemistry and Physical Pharmacy**	**Credits = 4**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 60**	**3**	**1**	**0**
	List of Prerequisite Courses				
	HSC Chemistry				
	List of Courses where this course will be prerequisite				
	Pharmaceutical Analysis-I, Pharmaceutical Analysis-II, Pharmaceutical Analysis Laboratory-I				
	Description of relevance of this course in the B. Pharm. Program				
To train the students with respect to Physical chemistry and its applications to Pharmaceutical Sciences					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
1	**Thermodynamics:** First law, second law, third law, thermochemistry, free energy function and its applications, chemical potential, Clausius-Clapeyron equation, free energy and equilibrium, the van'tHoffequation (With focus on applications and examples from biology and pharmacy field)		8		
2	**Physical properties of Drug Molecules:** Dipole moment and its determination,refractive index and molar refraction, rheology, micromeritics		6		
3	**Solutions of Nonelectrolytes:** Units for expressing concentration and calculations involving the same, ideal and real solutions, Raoult's law, Henry's law		4		
4	Colligative properties,elevation of B. P., depression of freezing point, osmoticpressure, molecular weight determination based on colligativeproperties, molecular weight by steamdistillation		4		
5	**Solution of Electrolytes:** Properties ofsolutionsofelectrolytes, Arrhenies theory of electrolytic dissociation, theory of strong electrolytes, coefficients for expressing colligative properties		5		
6	**Ionic Equilibria and Buffers**: Modern theories of acids and bases, Acid-Base equilibria, Sorensen's pH scale, calculationof pH, effect of pH on ionization of weak acid and weak bases, calculation of fraction unionized; The buffers in pharmaceutical and biological systems, buffered solutions, methods of adjusting pH		6		
7	Electromotive force andOxidation-Reduction: Electrochemical cells, Nernstequation, Types of electrodes, electrode, electrode potential, redox potential, concentration cell, measurement of pH		4		
8	**Solubility:**Solubility of gases in liquids, solubility of oxygen in blood, solubility of anaesthetic gases in blood, solubility of volatileanaesthetics in oil, miscible liquids, partial miscibility, solubility ofsolids in liquids, ideal solubility, solubility parameters and prediction of solubility in regular solutions, partition phenomena, partitioning ofweak electrolytes		5		
9	**Complexation:** Organic molecular complexes, inclusion compounds, methods of analysis, protein binding, Scatchard plot		3		
10	**Chemical Kinetics:**Molecularity and order of a reaction, specific reaction rateconstant, zero order, first order and second order reactions, methods to determine order of a reaction, Energy of activation,photochemical reactions and quantumyield		5		

11	**Catalysis:**Positive, negative catalyst,autocatalysis. Homogenous and heterogenous catalysis	3
12	**Interfacial Phenomena:** Surface tension (Surface free energy), Young equation,Kelvin equation, measurement of surface and interfacial tension, wetting and contact angle, spreading of liquids on liquidsand on solids, Surface activity and soluble monolayers, Gibb's Duhemequation, insoluble monolayers and the filmbalance	5
13	Adsorption at solid surfaces, Freundlich and Langmuir treatment to Type-Iadsorption isotherm, electrical propertiesof interfaces-Nernst and Zeta potential	2
	List of Text Books/ Reference Books	
1	Martin AN, Swarbrick J, Cammarata A, Physical Pharmacy-Physical Chemical Principles in Pharmaceutical Sciences. 2nd Edition, Lea &Febiger, Philadelphia, 1969	
2	J.W. Cooper, Colin Gunn,Tutorial Pharmacy, 4th edition, Sir Isaac Pitman & Sons Ltd., London, 1950	
3	Bahl BS, Essentials of Physical Chemistry., 23rd Edition, S. Chand &Sompany	
4	Allen, Loyd V., Jr, Remington-The Science And Practice Of Pharmacy (Vol.1& 2), 22nd edition, Lippincott Williams &Wilkins, 2012	
	Course Outcomes (students will be able to…..)	
1	Understand basics of Physical chemistry with respect to Physical pharmacy	
2	Understand applications of Physical pharmacy in pharmaceutical sciences	

	Course Code:PHT1113	**Course Title: Pharmaceutics -II**	**Credits = 3**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 45**	**2**	**1**	**0**
	List of Prerequisite Courses				
	Pharmaceutics-I				
	List of Courses where this course will be prerequisite				
	Pharmaceutics-III				
	Description of relevance of this course in the B. Pharmacy				
To train the students with basics and applied concepts of biphasic pharmaceutical products					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
1	**Introduction to basic of biphasic disperse system: Suspensions** Pre-formulation considerations Excipients in suspensions Principles of Suspension stabilization		4 3		
2	Formulation of suspensions for internal use Formulation of suspensions for external use		4 2		
3	Quality control of Suspension dosage forms		4		
4	Large scale manufacture, packaging, facility design and equipments for Suspensions		4		
5	**Introduction to basic of biphasic disperse system: Emulsions** Preformulation considerations Excipients used and Theory of emulsions		4 2		
6	Formulation of emulsions for internal use Formulation of emulsions for external use		3 3		
7	Quality control of emulsions dosage forms		4		
8	Large scale manufacture, packaging, facility design and equipments for emulsions		4		
9	**Advances in suspensions and emulsions**		4		
	List of Text Books/ Reference Books				
1	Howard C. Ansel, Nicholas G. Popovich, Lord V. Alien, Pharmaceutical Dosage Form And Drug Delivery Systems, 10th edition, 1995, B.I.Waverly Pvt.Ltd.,New Delhi, 2013				
2	Allen, Loyd V., Jr, Remington-The Science And Practice Of Pharmacy (Vol.1& 2), 22nd edition, Lippincott Williams &Wilkins, 2012				
3	J.W. Cooper, Colin Gunn,Tutorial Pharmacy, 4th edition, Sir Isaac Pitman & Sons Ltd., London, 1950				
4	Michael E. Aulton, Pharmaceutics: The Science Of Dosage FormDesign, Churchill-Livingstone, 1988				
5	S.J. Carter, Cooper & Guns. Dispensingfor Pharmaceutical Students 12th edition,Pitman Books, 1987				

6	Alfred N.Martin, James Swarbrick, Arthur Cammarata, Physical Pharmacy-Physical Chemical Principles In Pharmaceutical Sciences, 2nd edition, Lea &Febiger,Philadelphia, 1969	
7	Roop K. Khar, S. P. Vyas, Farhad J. Ahmad, Gaurav K. Jain, The Theory and Practice of Industrial Pharmacy- 4th Edition, CRS press, 2013	
8	Goseph. B. Sprowls, Prescription Pharmacy, 2nd, 1970	
9	Bentley and E. A. Rawlins, Bentley's Textbook Of Pharmaceutics, 8thedition, 1977	
10	Howard Ansel, Introduction Of Pharmaceutical DosageForms, 3rdedition, Lea &Febiger, 1981	
11	Pharmacopoeias: Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia, all editions	
Course Outcomes (students will be able to…..)		
1	Detail knowledge of suspension pharmaceutical products for w.r.t prefromulation, formulation, scale-up, packaging, quality control	
2	Detail understanding of emulsification theories	
3	Detail knowledge of emulsion pharmaceutical products for w.r.t prefromulation, formulation, scale-up, packaging quality control	

	Course Code: PHT1207	**Course Title: Anatomy, Physiology & Pathophysiology-I**	**Credits =4**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 60**	**3**	**1**	**0**
List of Prerequisite Courses					
	Biology				
List of Courses where this course will be prerequisite					
	Pharmacology, Medicinal chemistry, Clinical Pharmacy, Pharmaceutical Technology				
Description of relevance of this course in the B. Pharm. Program					
This will enable student to understand the basic structure, function and location of human body and apply it to understanding of pharmacology, clinical Pharmacy, health awareness, family planning and Pharmaceutical technology.					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	Structural Organization of human body, structure of human cell, cell membrane, membrane potential, Intracellular messengers: cyclic AMP, Adenyl cyclase, protein kinase, Phosphodiasterse, Cell injury and Inflammation, Physiology of pain.	**8**
2	Formation of body finds – Buffers of body, Respiratory and Metabolic acidosis and alkalosis	**5**
3	**Blood and Lymphatic system** Elements of blood, properties of blood, haemopoesis, clotting of blood, significance of Rh, factor clotting disorders, anaemia	**5**
4	Anatomy- Physiology and Importance of Lymphatic system Immunity – Cell mediated/humoral/Active/Passive Diseases- AIDS, allergy, Myasthemis gravis, SLE	**5**
5	**Respiratory system:** Anatomy – Physiology Exchange of gases, mechanismof respiration at lung and tissue level, Respiratory volumes, Neural and chemicalregulation of respiration, O_2,CO_2carriage, hypoxia.	**5**
6	Diseases: COPD, Asthma, pneumonia, emphysema, pulmonary embolism, acute respiratory failure.	**5**
7	**Muscular system:** Anatomy-Physiology of smooth and skeletal muscles Physiology of NMJ, Skeletal muscles contraction, energy metabolism, types of contraction of muscles. Definition: Myasthemis gravis, tetanus, spasticity.	**7**
8	**Reproductive System:** Anatomy- Physiology of male and female reproductive system, Menstruation, Oocytogenesis, Spermatogenesis.	**5**
9	**Endocrine system:** Anatomy- Physiology of pituitary, thyroid and parathyroid glands	**5**
10	Anatomy- Physiology of adrenal, pancreas, testis, ovaries, control of hormone secretion. Diseases associated with hypo-hypersecretion of hormones.	**5**
11	Pathophysiology of Diabetes Mellitus	**5**

List of Text Books/ Reference Books	
1	Anne Waugh and Allison Grant, Ross and Wilson's Anatomy and Physiology in Health and Illness 12th edition, Churchill Livingstone, London, 2014
2	Gerald J. Tortora and Sandra, Principles of Anatomy and Physiology 14thedition, John Wiley and Sons Inc, New York, USA, 2014
3	Arthur C. Guyton and John E. Hall, Textbook of Medical Physiology, 13thedition, W. B. Saunders Company, 2016
4	B. R. Mackenna and R. Callander, Illustrated Physiology, 6th, Churchill Livingstone, New York, London, 1997
Course Outcomes (students will be able to.....)	
1	Understand the organization, placement, structures and functioning of human body as whole including intracellular messengers, cell injury, inflammation and pain
2	Understand the body fluids; namely, blood, lymph, and the transcellular, their formation, presence and functions(buffers) as well as disorders
3	Understand the anatomy and physiology of systems namely respiratory, endocrine, muscular and reproductive with the disorders affecting the systems

	Course Code: PHT1304	**Course Title: Pharmaceutical Analysis-I**	**Credits = 3**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	HSC Chemistry, Inorganic Chemistry, Organic Chemistry-I and Organic Chemistry-II				
List of Courses where this course will be prerequisite					
	Pharmaceutical Analysis-II and Pharmaceutical Analysis-III				
Description of relevance of this course in the B. Pharm. Program					
To train the students with respect to basics of titrations and electroanalytical chemistry					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	**Introduction to pharmaceutical analysis** Difference between qualitative and quantitative analysis. Causes of errors. Accuracy and precision. Significant figures.	2
2	**Introduction to pharmacopoeial monograph** -Drug and formulation	2
3	**The theoretical basis of quantitative analysis** Equivalent weight, Standard volumetric solutions. Normality, molarity, molality, formality, characteristics of a primary standard; Secondary standard, Titration. Types of titration. titrant, analyte, theory of indicator, concept of end point, direct titration, back titration, blank titration. Stoichiometric calculations and calculation of factor. Electrolytic dissociation, the law of mass action and its application to solutions of weak electrolytes. Hydrolysis of salts. Solubility product, common ion effect	6
4	**Acid base titration** Buffer and buffer capacity In aqueous media and non aqueous media. Dissociation constant, pH.Neutralisation curves-(strong acid by strong base, weak acid by strong base, weak base by strong acid, and weak acid by weak base). Neutralisation indicators. Direct titration of strong/ weak acids. Direct titration of weak/ strong bases. Back titration. Examples of pharmaceutical applications for each method. Need for non aqueous titrations. Classification of non aqueous solvents and their examples and pharmaceutical applications. Problems based upon acid-base titrations	9
5	**Precipitation titration** Theoretical considerations**-**Common Ion Effect, Solubilty Product, Factors affecting solubility of precipitates, Fractional precipitation. Argentometric, Non– Argentometric titrations Mohr's method, Volhard's method, Adsorption Indicators	2
6	**Oxidation – Reduction titration** Concept of oxidation and reduction, oxidation numbers, half reactions**.** Standard oxidation reduction potential. Nerst equation, Oxidation reduction indicators. Permanganate titration, Iodimetric titration, Iodometric titration, Cerimetric titration. Problems based upon redox titrations	7

7	**Complexometric titration** Difference between complex and a chelate, Coordinate numbers, ligands, complexing agent and chelating agent.Effect of pH on complex formation, pM indicators – Calcon, mordant black II, murexide, xylenol orange. Masking and demasking agents. Pharmaceutical examples of direct and back titration with EDTA.	4
8	**Miscellaneous methods of analysis** Gravimetric analysis - Precipitation from solution, Chemical reactions in assays involving sulphate as barium sulphate calcium as calcium oxalate. Kjeldahl method–Determination of Nitrogen, Karl Fischer method - Determination of water (Aquametry), Sodium nitrite titration Analytical constants including Acid value, Saponification value, Ester value,Iodine value, Acetyl value, Reichert Meissl (RM) value – significance andprinciple involved in their determination.	7
9	**Introduction to Electro Analytical Techniques:** Principle and application to pharmaceuticals- Potentiometry - Nernst Equation, Half cell potential, glass electrode, examples of potentiometric titrations, ion selective electrode. Conductometry, Polarography, Amperometry, Coulometry, Electrogravimetry	6
	List of Text Books/ Reference Books	
1	Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, 7th edition, ELBS/Longman, Londo, 1988	
2	Ewing. Grant, Statistical Quality control 6. Instrumental methods of Analysis, 6thedition, McGraw Hill, 1988	
3	Connors KA, A Textbook of Pharmaceutical Analysis, 3rdedition, Wiley Interscience, New York, 1982	
4	Beckett A. H. and Stenlake JB, Practical Pharmaceutical Chemistry Vol. I, 4thedition .The Anthlone Press of University of London, 1988	
5	Skoog/ West/Holler, Analytical Chemistry an Introduction, 4thedition, CBS Publications, Japan , 1986	
6	Garrat, The Quantitative Analysis of Drug 3rdedition, Toppan & Co, 2005	
7	Gary Christian, Analytical Chemistry, 3rdedition, John Wiley, 1971	
	Course Outcomes (students will be able to…..)	
1	Quantitative analysis of drugs, formulations & excipients by titrimetry	
2	Quality control tests for pharmaceutical products in industry	

	Course Code: MAT1202	**Course Title: Mathematics & Statistics – II**	**Credits = 3**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 45**	**2**	**1**	**0**
	List of Prerequisite Courses				
	HSC Mathematics, Mathematics & Statistics – I				
	List of Courses where this course will be prerequisite				
	Biopharmaceutics and Pharmacokinetics, Biostatistics, Computer Laboratory				
	Description of relevance of this course in the B. Pharm. Program				
To train the students with respect to basics of mathematics and statistics and its application in Pharmaceutical Sciences					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
1	Arithmetic and Geometric means, median and mode, range, deviation, mean and standard deviation, coefficient of variation, moments, skewness and kurtosis		2		
2	**Probability Distribution:** Discrete and continuous random variables, probability distribution functions, expectation of random variables, mean, variance and moments of random variables, moment generating function, binomial and geometric distribution, Poisson distribution, normal distribution, uniform and gamma-beta distributions		14		
3	Population and sampling, determination of sample size		3		
4	**Hypothesis Testing:** Introduction to hypothesis testing, Z-test, Students t-test for single sample multiple samples, paired t-test, chi-square distribution		8		
5	**Design of Experiments**: ANOVA (One way ANOVA and Two way ANOVA) Application in identification of statistical difference between responses, selection of appropriate test for pharmacokinetic and pharmacodynamic response analysis		9		
6	**Correlation and Regression**: linear and nonlinear regression, multilinear regression, correlation, calculation of similarity factor (f2 value) and difference factor (f1 value) Application to Invitro dissolutions analysis, IVIVC		9		
	List of Text Books/ Reference Books				

1	Sheldon Ross, A First Course In Probability, 6th Edition, Prentice Hall, 2002	
2	Gupta SP, Statistical Methods, 2nd Edition, S. Chand & Co, 1969	
3	Lachmen, Theory and practice of Industrial Pharmacy., 3rd Edition	
4	Brahmankar DM, Jaiswal SB, Biopharmaceutics and Pharmacokinetics	
5	Gujar K, Mathematics-for-Pharmacy Students Vol. I (Calculus.)	
6	Gujar K, Mathematics-for-Pharmacy Students Vol. II (Stat.)	
7	Johnson R, Miller I, Freund J, Miller & Freund's Probability And Statistics For Engineers. 7th Edition, Pearson Education, 2005	
8	Bolton S, Bon C, Pharmaceutical Statistics: Practical And Clinical Applications, 4th Edition, Marcel Dekker, 2004	
9	Rowe P, Essential Statistics For The Pharmaceutical Sciences, 1st Edition, John Wiley Sons ltd, 2007	
10	Jones D, Pharmaceutical Statistics,1st Edition, Pharmaceutical Press UK, 2002	
11	Douglas CM, Alasdair GM, Nairn G, Runger, Applied Statistics And Probability For Engineers.4th Edition, Wilely, 2006	
Course Outcomes (students will be able to…..)		
1	Appreciate the importance of mathematics and statistics with relevance to pharmaceutical sciences	
2	Understand relevant applications	

	Course Code:PHP1111	**Course Title: Pharmaceutics Laboratory – I**	**Credits = 2**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Pharmaceutics-I				
List of Courses where this course will be prerequisite					
	Pharmaceutics Laboratory – II, Dispensing Pharmacy Laboratory, Cosmeticology Laboratory				
Description of relevance of this course in the B. Pharmacy					
To train the students with respect to practical aspects of monophasic and biphasic pharmaceutical formulation development and quality control thereof					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	Representative examples of monophasic liquids (Preparation, packaging and evaluation)	24
2	Representative examples of Emulsions (Preparation, packaging and evaluation)	20
3	Representative examples of Suspensions (Preparation, packaging and evaluation)	16
Course Outcomes (students will be able to…..)		
1	Understand basic calculations for formulation(%w/w, %w/v, %v/v), concepts of dilution	
2	Prepare ,evaluate and label pharmacopoeial and non Pharmacopoeial monophasic liquid oral formulations	
3	Prepare, evaluate and label pharmacopoeial and non pharmacopoeial suspensions	
4	Propose type of container specific to product application	

	Course Code: PHP1103	**Course Title: Physical Pharmacy laboratory - I**	**Credits = 2**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	HSC Chemistry				
List of Courses where this course will be prerequisite					
	Not applicable				

Description of relevance of this course in the B. Pharm. Program		
To train the students with respect to practical Physical chemistry and its applications to Pharmaceutical Sciences		
Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	**Kinetics: Experiments to determine order of reaction** i. First order Reaction a) degree of hydrolysis b) relative strength oftwo acids c) equal fraction method ii. Second order reaction a) a=b b) equal fraction method c) Oswald's dilution method	4
2	**Energy of activation and determination ofshelflife**	4
3	**Kinetics of inversion of cane sugar**	4
4	**MolecularWeight determination** i. F.P. Method ii. B.P. Method iii. Rast camphor method iv. Molecular weight of polymer by viscosity method v. Victor Meyer method	4
5	**Suface Tension** i. Usingstalagmometer ii. Critical micelle concentration ofa surfactant iii. Determination of HLB	4
6	**Conductivity** i. Normality of an acid by conductometric titration ii. Dissolution constant of an acid (verification of Ostwald's dilution (w) iii. Solubilityof a sparingly soluble salt iv. pHmeter	4
7	Potentiometric titration	4
8	Dissolution constant of a weak acid	4
9	To determine buffer capacity at various stages of titrations of a weak acid against strong base and hence to determine pKa of the acid	4
10	**Adsorption** Adsorption of acetic acid on activated charcoal anddetermination of specific surface area of charcoal	4
11	**Partition** i.Partition coefficient of lodine between carbontetrachloride and water ii.Partition coefficient of benzoic acid between water and benzene	4
12	**Chromatography** i.paper chromatography (aqueous phase only), Rf value determination	2
13	Critical solution temperature phenol water system	4
14	Heat of solution – by solubility method Heat of neutralisation – using a thermosflask	4
15	**Micromeritics** i.Determination of particle size using microscopy ii. Determination of particle size using laser diffraction techniques (demonstration)	2
16	**Rheology** Viscosity determination using a) Ostwald's viscometer b) Brookfield's viscometer/ Cone and plate viscometer d) Falling ball method	4
Course Outcomes (students will be able to…..)		
1	Understand practical aspects of physical chemistry	
2	Understand applications of physical pharmacy in pharmaceutical sciences	

	Course Code: PHP1304	Course Title: Pharmaceutical Analysis Laboratory-I	Credits = 2		
			L	T	P
	Semester: II	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
	HSC Chemistry				
List of Courses where this course will be prerequisite					
	Pharmaceutical Analysis Laboratory-II				
Description of relevance of this course in the B. Pharm. Program					
To train the students with respect to titration skills and other basic analytical techniques					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	The students should be introducing to the main Analytical tools through demonstration. They should have a clear understanding of a typical analytical balance, weights, care anduse of balance, methods ofweighing and errors of weighing. The students should also be acquainted with the generalapparatus required in various analytical procedures.	2
2	Standardization of analytical weights and calibration of balances and volumetricapparatus.	2
3	Perform following assays as per IP including preparation and standardization oftitrants.Such as 0.1 N HCL, 0.1 N NaOH, 0.1 N $KMnO_4$, 0.1 N $Na_2S_2O_3$, 0.1 N $AgNO_3$, 0.1N $HClO_4$, 0.05 M disodium EDTA, 0.1 N CH_3ONa, 0.1 N Iodine, 0.1 N Oxalic acid	8
4	Hydrogen ion concentration, pH, and potentiometric titrations	4
5	Acid-base titrations**: Benzoic acid, Boric acid, Aspirin, Determination of totalalkalinity and sodium carbonate of sodium hydroxide	4
6	Non-Aqueous titrations**: Sodium acetate, Sodium benzoate, Norfloxacin tablet. assay of pyridoxine HCI	4
7	Oxidation-Reduction titrations**: assay of sodium nitrite Ferrous sulfate, Ascorbicacid, Isoniazide, Hydrogen Peroxide. assay of iodine solution, determination of percentage of ascorbic acid	8
8	Complexometric titrations**: Magnesium sulfate, Lead nitrate, calcium gluconate,Ca & Mg in a mixture, AI & Zn in a mixture ,assay of aluminium hydroxide gel	4
9	Argentometric titrations**: Potassium chloride, Sodium chloride and Ammoniumchloride.	4
10	Gravimetric analysis**: Alum by oxime reagent, Calcium as calcium oxalate andmagnesium as magnesium pyrophosphate.	4
11	Miscellaneous methods of analysis:** Estimation by Kjeldahl's method, sodium nitrite titration, hydroxyl value, acid value, iodine value, saponification value, ester value	8
12	Limit Test of the following (1) Chloride (2) Sulphate (3) Iron (4) Arsenic	8
	**Applications may also include other compounds to which the techniques are applicable.	

List of Text Books/ Reference Books		
	Books recommended under Pharmaceutical Analysis-II And in addition the following	
1	Ewing, Instrumental Methods Of Analysis. 4th edition, McGraw Hill New York, 1975	
2	Furniss, Brian S. Vogel's textbook of practical organic chemistry, Pearson Education India,	
Course Outcomes (students will be able to…..)		
1	Understanding importance of analytical accuracy	
2	Appreciate basic laboratory analytical techniques	

SECOND YEAR B.PHARM SEMESTER III

	Course Code: PHT1406	**Course Title: Pharmaceutical Organic Chemistry III**	**Credits = 3**		
			L	**T**	**P**
	Semester: III	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Organic Chemistry II				
List of Courses where this course will be prerequisite					
	Pharmaceutical chemistry and Medicinal Chemistry courses				
Description of relevance of this course in the B. Pharm. Program					
To train the students with respect to basics of mechanism of organic reactions, stereochemistry, and aliphatic chemistry					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	**Stereochemistry**	
	Origin of Stereochemistry, Criteria for presence of chirality in molecule: axis of symmetry, plane of symmetry, centre of symmetry.	4
	Resolution of a racemic mixture. Atropisomerism in biphenyls.	
	Stereospecificity and stereoselectivity in organic reactions: S_N1,S_N2,E1,E2 and E1cb reactions,syn and anti-additions of H_2 to alkynes, addition of halogens(X_2),halohydrin formation (X_2 and H_2O); $KMnO_4$,OsO_4 and alkaline H_2O_2 addition to alkenes, hydroboration –oxidation, oxymercuration-demercuration of alkenes.	5
	Conformations: n-Butane, Cyclohexane	3
	Types of strains: Angle strain, Transannular strain, Bayer strain, Pitzer strain stability, optical activity and conformational analysis of mono and disubstituted cyclohexanes (1,2/1,3/1,4 disubstituted with -OH,-X, t-butyl,-COOH like groups)	
	Application of the concept to pharmaceutical and medicinal chemistry	1
2	**Heterocyclic Chemistry**	
	Characteristic properties and reactivity of 5 and 6 membered monocyclic heteroaromatic compounds with 1 or more heteroatoms	4
	Bicyclic heteroaromatics, Polyaromatics	3
3	**Molecular Orbital Theory**	3
4	**Pericyclic Reactions**	3
5	**Free Radical Reactions –** Basic concepts and applications in pharmaceutical chemistry	4
6	**Functional Group Conversions and basic Concepts of retrosynthesis**	
	Functional group conversions common in reactions in retrosynthesis	5
	Basic concepts of retrosynthesis	5
	Application of retrosynthesis to simple molecules	5

List of Text Books/ Reference Books		
1	J. McMurry, Brooks/Cole, Organic Chemistry	
2	T.W.G. Solomons, C.B. Fryhle, Organic Chemistry, John Wiley and Sons Inc.,	
3	L.G. Wade Jr, Organic Chemistry, Pearson Education	
4	E.L. Eliel, StereoChemistry of Carbon compounds, Mcgraw-Hill	
5	Paula Y. Bruice, Organic Chemistry, Pearson Education	
6	Joseph E. Rice, Organic Chemistry concepts and applications for medicinal chemistry, Elsevier, 2014	
7	Staurt Warren, Designing Organic Syntheses A programmed Introduction to the Synthon Approach, John Wiley & Sons, Inc	
8	Iyer RP and Degani M.S, Synthesis of Drugs: A synthon Approach Vol-1, 2nd Ed. Sevak publications Pvt. Ltd	
Course Outcomes (students will be able to…..)		
1	Understand the concepts of stereochemistry in detail with application to pharmaceutical and medicinal chemistry	
2	Comprehend properties and reactivity of heterocyclics	
3	Apply reterosynthesis to synthesis of simple organic molecules	
4	Grasp concepts of molecular orbital theory and free radical reactions, with relevance to pharmaceutical chemistry	

	Course Code:PHT1114	Course Title: Pharmaceutics III	Credits = 3		
			L	T	P
	Semester: III	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Pharmaceutics-II				
List of Courses where this course will be prerequisite					
	Pharmaceutics-IV, Cosmeticology				

Description of relevance of this course in the B. Pharmacy

In-depth knowledge of semisolid pharmaceutical products, aerosols, suppositories and stability studies .

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	**Semisolid dosage forms :** Anatomy of skin, percutaneous absorption Introduction to semisolid dosage forms, rationale, advantages and limitations Preformulation considerations for semisolid dosage forms	4
2	**Ointments:** Introduction, types of bases, ointment base selection criteria, methods of formulation, equipments used	4
3	**Creams:** Introduction, types of bases, base selection criteria, methods of formulation, equipments used	3
4	**Gels:** Introduction, types of gelling agents, gelling agent selection criteria, methods of formulation, equipments used	3
5	**Pastes and poultices:** Introduction, methods of formulation, equipments used	2
6	**Scale-up and Quality control of semisolid dosage forms :** • Quality control of semisolids • Packaging of semisolids • Scale up and facility design • Advances in semisolid dosage forms	5
7	**Introduction to Aerosols:** • Anatomy of lung, Introduction to pulmonary route of administration • Introduction to aerosols, rationale, advantages and limitations • Components of aerosols :Pressurized and non pressurized	5
8	**Formulation of Aerosols:** • Preformulation considerations for aerosols, types of aerosol systems like solution, suspensions, foam systems etc. • Selection criteria, excipients, methods of formulation, equipments used for aerosols preparation	2
9	**Scale-up and Quality control of aerosols :** • Quality control of aerosols • Packaging of aerosols • Large scale manufacture	3
10	**Suppositories:** • Anatomy of rectum and rectal absorption • Introduction, rationale, advantages and limitations • Preformulation considerations for Suppositories • Types of Suppositories bases • Displacement value and mathematical problems • Methods of formulation	4
11	**Scaleup , Quality control of Suppositiories :** • Problems in suppositories and solutions thereof • Quality control of Suppositories, • Large scale manufacture,packaging and layout design	5
12	**Stability studies:**	5

	• Introduction to International Conference on Harmonization • Climatic zones as per ICH • ICH guidelines for Stability Testing of New Drug Substances and Products [Q1A (R2)] • ICH guidelines for Stability Testing : Photostability Testing of New Drug Substances and Products [Q1B] • ICH guidelines for Stability Testing for New Dosage Forms [Q1C] • Stabilization of dosage forms	
List of Text Books/ Reference Books		
1	Herbert A. Lieberman, Martin A.Rieger, G.S.Banker, Pharmaceutical Dosage Form: Dispersed Systems (Vol.1 &2), 2nd edition , Marcel Dekker Inc, 1993	
2	Gilbert S.Banker, C.T. Rhodes, Modern Pharmaceutics, ,4th Edition, Marcel Dekker Inc, 2002	
	Howard C. Ansel, Nicholas G. Popovich, Lord V. Alien, Pharmaceutical Dosage Form And Drug Delivery Systems, 10th edition, 1995, B.I.Waverly Pvt.Ltd.,New Delhi, 2013	
4	Allen, Loyd V., Jr, Remington-The Science And Practice of Pharmacy (Vol.1& 2), 22nd edition, Lippincott Williams &Wilkins, 2012	
5	J.W. Cooper, Colin Gunn,Tutorial Pharmacy, 4th edition, Sir Isaac Pitman & Sons Ltd.,London, 1950	
6	Michael E. Aulton, Pharmaceutics: The Science Of Dosage FormDesign, Churchill-Livingstone, 1988	
7	Roop K. Khar, S. P. Vyas, Farhad J. Ahmad, Gaurav K. Jain, The Theory and Practice of Industrial Pharmacy- 4th Edition, CRS press, 2013	
8	Graham C.Cole, Pharmaceutical Production Facilities:Design& Applications, 2st Edition , Ellis Horwood, 1998	
10	Pharmacopoeias: Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia, all editions	
11	ICH Guidelines	
Course Outcomes (students will be able to…..)		
1	Detail the principles of percutaneous absorption, formulation and evaluation of different semi-solid formulations.	
2	Describe aerosols with respect to components, manufacture and evaluation.	
3	Describe factors affecting rectal absorption, formulation and evaluation of rectal delivery system.	
4	Explain stability evaluation, shelf life determination and strategies for stabilization	

	Course Code: PHT1208	**Course Title: Anatomy, Physiology & Pathophysiology-II**	**Credits = 4**		
			L	**T**	**P**
	Semester: III	**Total contact hours: 60**	**2**	**1**	**0**
List of Prerequisite Courses					
	Biology, Chemistry and Physics				
List of Courses where this course will be prerequisite					
	Pharmacology, Clinical Pharmacy, Biochemistry, Molecular biology.				
Description of relevance of this course in the B. Tech./B. Pharm. Program					
This course will enable a student to understand the basics of important body systems and the related disorders, and application of the same to pharmaceutical technology and health awareness programmes					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
1	Nervous System/sense organs. Anatomy-Physiology of CNS (Central N.S)		8		
2	Anatomy-Physiology of PNS (Peripheral NS) and ANS (Autonomic NS)		5		
3	Neurotransmitters, Neurotransmission, Sensory- Motor pathways; Cranial – Spinal Nervous; Blood –Brain Barrier, Blood flow to brain		5		
4	Diseases – Parkinsonism, Alzheimer's and epilepsy		3		
5	**Sense organs:** Anatomy and Physiology; Physiology of sensations (special)		4		
6	**Digestive System|:** Anatomy-Physiology including liver, pancreas Diseases: Peptic Ulcers, hepatitis		8		
7	**Cardiovascular System:** Anatomy – Physiology Structure and conducting systems of heart. Generation of action potential in SA node and itsconduction/		10		

	Action potential in cardiac muscle. Cardiac cycle,ECG, (P-QRS-T)	
8	Blood pressure-factorsmodifying blood pressure Baroreceptors, Chemoreceptors, Vasomotor centre, humoral and neuronal regulation of Blood pressure and Circulation	5
9	Diseases: Hypertension, CCF, Arrhythmia, angina pectoris, IHD, arteriosclerosis.	5
10	**Urinary System:** Anatomy – Physiology Function of kidneys and formation of urine. Maintainence of acid- base and electrolyte balance, Renin-angiotensin system.	6
11	Urine analysis- Volume, colour, odour, specific gravity, normal and abnormal constituents with associated diseases.	1
	List of Text Books/ Reference Books	
1	Anne Waugh and Allison Grant, Ross and Wilson's Anatomy and Physiology in Health and Illness , 12th edition, Churchill Livingstone, London, 2014	
2	Gerald J. Tortora and Sandra, Principles of Anatomy and Physiology, 14th edition, John Wiley and Sons Inc, New York, USA, 2014	
3	Arthur C. Guyton and John E. Hall, Textbook of Medical Physiology, 13th edition, 2016, W.B.Saunders Company, Pensylvania, U.S.A, 2016	
4	B. R. Mackenna and R. Callander, Illustrated Physiology 6th edition, , Churchill Livingstone, New York, London, 1997	
	Course Outcomes (students will be able to…)	
1	Understand the Anatomy and Physiology of human nervous system and the common disorders affecting the human nervous system.	
2	Understand the Anatomy and Physiology of human digestive system and the common disorders affecting the human digestive system.	
3	Understand the Anatomy and Physiology of human urinary system along with buffers of the body and the common disorders affecting the human Urinary system.	
4	Understand the Anatomy and Physiology of human cardiovascular system and the common disorders affecting the human cardiovascular system.	

	Course Code: PHT1305	**Course Title: Pharmaceutical Analysis II**	**Credits = 3**		
			L	**T**	**P**
	Semester: III	**Total contact hours: 45**	**2**	**1**	**0**
	List of Prerequisite Courses				
	Pharmaceutical Analysis-I**,** Physics, Organic Chemistry,				
	List of Courses where this course will be prerequisite				
	Pharmaceutical Analysis-III, Pharmaceutical Analysis-lab I				

Description of relevance of this course in the B. Pharm. Program

To train the students with respect to understand pharmacopoeial monographs, atomic and molecular spectroscopic techniques, Solvent extraction, Refractometry and polarimetry.

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	**Introduction:** Pharmacopoeial monograph, literature collection, data handling and expression of analytical results – documentation and record keeping	5
2	**Solvent extraction** : Basic principles, classification, mechanism of extraction, equilibria, techniques and applications	5
3	**Refractometer:** Theory, instrumentation and application.	5
4	**Polarimetry**: Theory, instrumentation and application.	5
5	**UV Visible Spectroscopy:** Introduction to interaction between electromagnetic radiation and matter, absorption of radiation by molecules, Molecular structure and electronic spectra-theory of electronic transitions and electronic spectra, spectra of isolated chromophores definitions - auxochromes, bathochromic shift, hypsochromic shift; Hyperchromism and hypochromism, Effect of solvent on absorption spectra	5
6	Quantitative uses of absorption, Spectroscopy-Beer and Lambert's law and its derivation, limitation of	5

	Beer's law, application of Beer's law to single component analysis and multi-component systems (Simultaneous equation method, Absorbance ratio method, Difference spectroscopy and derivative spectroscopy).	
7	Instrumentation of UV visible spectrophotometer, single beam UV visible spectrophotometer and double beam spectrophotometer, Woodward fisher Rule	4
8	**Infraredspectroscopy:** Molecular structure and infra-red spectra, vibrational transition frequency-structure correlations. various regions of infra-red bands-hydrogen stretching, C-C stretching, C=C stretching and bending ,effect of hydrogen bonding; Measurement of absorption spectra, Instrumentation-discussions of light sources, frequency selector, Intensity control detectors, samples, preparation, ray diagrams of typical I.R .spectrophotometers; Near IR spectroscopy – Different applications in pharmaceutical industry, sampling techniques; Difference between FTIR and Dispersive IR	4
9	**Fluorescencespectroscopy:** Theory of fluorescence phenomenon-origin of fluorescence and phosphorescence multiplicities, singlet and triplet states; Excitation and fluorescence spectra, Molecular structure and fluorescence; Quantitative fluorescence analysis; Practical fluorescence analysis: Application of fluorescence analysis to drug: Instrumentation	5
10.	**Nepheloturbidometry and Electrophoresis**	2
	List of Text Books/ Reference Books	
1.	Beckett, A.H & Stenlake, J.B, Practical pharmaceutical chemistry, 4thEdn. (Part II), CBS Publishers & Distributors, India, 1988.	
2.	Lee D.C & Webb M.L, Pharmaceutical analysis, Wiley-Blackwell, 2009.	
3.	Christian, G.D, Analytical chemistry, 6thedition, John Wiley & Sons. New York, 2003.	
4.	Mendham, J., Denney R.C., Barnes J. D. and Thomas M.J.K., Vogel's Textbook of quantitative chemical analysis, 6thedn, Prentice Hall, 2000.	
5.	Svehla, G, Vogel's qualitative inorganic analysis, 7th edition, Prentice Hall, 1996.	
6.	Pavia D.L., Gary M.L., George S.K. and James. A.V.,Introduction to Spectroscopy, Wadsworth Publishing Co Inc; 4thedition, 2008	
7.	Skoog and West, Principlesof Instrumental Analysis, 4thedition, Saunders College Publishing,USA, 1992.	
8.	WillardH.H.L. L. Merrit & John A., Instrumental Method of Analysis, 6thedition,CBS Publishers & Distributors, New Delhi, 1986.	
9.	William Kemp, Organic Spectroscopy, 3rdedition, Reprinted, Palgrave Publishers Ltd., New York, 2005	
10.	Indian Pharmacopoeia	
11.	British pharmacopoeia	
12.	United States pharmacopoeia	
	Course Outcomes (students will be able to…..)	
1	Describe the fundamental phenomenon underlying each of spectroscopic techniques. and instrumentation.	
2	Define and explain glossary with examples in each techniques	
3	Solve the problems based on spectroscopic and solvent extraction techniques.	
4	Able to correlate the knowledge of spectroscopic techniques with Pharmacopoeial monographs.	
5	Solve the problems based on refractometry and polarimetry.	

	Course Code: BST1302	**Course Title: Biochemistry**	**Credits = 4**		
			L	**T**	**P**
	Semester: III	**Total contact hours: 60**	**3**	**1**	**0**
	List of Prerequisite Courses				
	10th std. Biology; 12th std Chemistry				
	List of Courses where this course will be prerequisite				
	Pharmaceutical and Biochemical Analysis Laboratory, Pharmaceutical Biotechnology, Process Technology and Biotechnology Laboratory				
	Description of relevance of this course in the B. Tech./B.Pharm. Program				
	To train the students to understand and explain core principles of biochemistry in a consolidated manner; know major types of biomolecules and their detailed chemical characteristics; basic energy metabolism of cells ; different biochemical pathways and their significance to various metabolic disorders and the role of enzyme structures and functions for biochemical pathways and determine basic enzyme kinetics				
Sr. No.	**Course contents (topics and subtopics)**		**Reqd. hours**		

1	**Study of Macromolecules**	
	Chemistry of carbohydrates: families, structures, types: mono, di and polysaccharides; Application in diagnostics, Chemical tests for carbohydrate analysis Metabolism: Glycolysis, Gluconeogenesis, Glycogen synthesis, Kreb's cycle, HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency,glycogen storage diseases (GSD) Hormonal regulation of blood glucose level and Diabetes mellitus	4 6
	Study of lipids: fatty acids, FA esters, structural lipids such as waxes, phospholipids, sphingolipids, sterols and lipoproteins; chemical tests for lipid analysis β-oxidation, biosynthesis of fatty acids, triacylglycerol, isoprenoids, sterols; Lipids as markers for inherited diseases	7
	Structure of proteins: introduction to amino acids structures, overview of protein structure, types of proteins- globular, fibrous (helix & pleated sheet) ; Colour reaction of amino acids, medical relevance of protein misfolding, Solid phase peptide synthesis, Edman reaction based protein sequencing and its automation; Metabolic fates of amino acids, Nitrogen excretion and urea cycle; Biosynthesis of aminoacids	7
	Nucleic acid Chemistry: structure, bonds, synthesis and sequencing methodologies, cellular functions Purine and pyrimidine metabolism: Denovo and salvage pathways, degradation pathways; Examples of drugs interfering with these pathways	4 4
2	**Role of water in cell metabolism** Buffers, pH, physiological role	3
3	**Vitamins & Co-enzymes** Structures & function: Nicotinamide, nicotinic acid, riboflavin, lipoic acid, biotin, thiamine, B6, folic acid, B12, pantothenic acid, ascorbic acid, vitamins A, D, K, and E	4
4	**Enzymes** Classification of enzymes, Mechanisms of catalysis-acid base catalysis; oxidation-reductions; proximity effects; transition state theory, Enzyme kinetics-Michaelis-Menten equation and meanings of Km and Vmax, Lineweaver Burke method. Enzyme inhibition–competitive, non-competitive and uncompetitive reversible inhibition of enzymes. Effect of these inhibitors on Km and Vmax and Identification of inhibition patterns via LWB plots. Examples of drugs that are enzyme inhibitors; Regulatory Enzymes-Allostery	4 4 4
5	**Biochemical Energetics** Concept of free energy, standard free energy vs transformed free energy vs free energy for a reaction. Relationship of standard free energy to reaction equilibrium constant, concepts of enthalpy and entropy, introduction to first and second law of thermodynamics. Standard free energy changes of some important biological rections. Concept of oxidation – reduction reactions, standard electrode potential, transformed standard electrode potential, standard electrode potentials of some biological important redox couples. Concept of high energy phosphate bond and ATP as a carrier of energy. Electron transport chain: Components of the ETC, oxidative phosphorylation vs substrate level phosphorylation. Discussion or proton motive force and generation of ATP by use of proton gradients. Examples of some toxins that interfere with ETC.	3 3 3
List of Text Books/Reference Books		
1	Lehninger AL, Nelson DL and Cox MM , Principles of Biochemistry, 5thEdition, MacMillan, 2008	
2	Berg, Jeremy M., John L. Tymoczko, Lubert Stryer, and L. Stryer. Biochemistry. 5th edit. 2002.	
3	Murray, R. K., D. K. Granner, P. A. Mayes, and V. Rodwell. W. Harper's Illustrated Biochemistry 26th Edition ed. 2003.	
Course Outcomes (students will be able to)		
1	Understand the significance of Biochemistry in Pharmaceutical sciences	
2	Comprehend and apply laws of thermodynamics and its relation to biological systems	
3	Able to connect biological pathways to drug action	
4	Understand and apply the principles of analytical tools and its relation to evaluation of biological system based on studies of enzymes	
5	Appreciate how biomolecules can be used as biomarkers to track diseased state.	

	Course Code: HUT1103	Course Title: Sociology and Ethics	Credits = 3		
			L	T	P
	Semester: III	Total contact hours: 45	2	1	0

List of Prerequisite Courses	
Communication skills and Psychology	

List of Courses where this course will be prerequisite	
-	

Description of relevance of this course in the B.Pharm. Program

Important to understand social behaviour and ethical values in the application of pharmacy in technology and to society

Sr. No.	Course contents (Topics and subtopics)	Reqd. hours
	SOCIOLOGY	
1.	Introduction to Sociology – a) Origin and definition of sociology; nature of sociology as a science b) Scope of sociology and its relevance to the industry (specifically, pharma) c) Basic concepts in Sociology – society, social structure, social groups and social institutions d) Social groups and Culture e) Determinants of Social Development & social change: Individual Personality, social behavior, socio-cultural development	6
2.	Applications & relevance of Sociology – a) Sociology as a profession – policy, planning, teaching, research b) Career opportunities in Sociology – Social work, NGO, Media, Social Welfare organisations, Labour welfare, Criminology, Jornalism, Industry (CSR/HRD/HRM) c) Industrial Democracy: What is Industrial Democracy? Worker participation in management; Trade unions: History of labour movement in India, Problems of trade unions in India, collective bargaining, industrial disputes, social adjustment of workers, d) Meaning, definition and factors of social change – cultural, technological, geographic, demographic factors leading to diversity or cultural lag, Unity in diversity e) Barriers in communication reduced or minimised, definition and levels of communication, improving communication in organization	8
3.	Organisation of work in Industry (specially Pharma) a) Workers in formal and informal sector - Impact of science & technology on industry and society, the role of industry in national development, cottage, small and large scale industries, problems of industrialization with special reference to the pharmaceutical industry b) Management- Employee relations - Human Resource Management, Collective Bargaining, Trade Unions c) Liberalisation, Privatisation, Globalisation - impact on pharma industry d) Contemporary issues in Pharmaceutical Marketing • Producer to Consumer • E-detailing –information of products on internet • Customer relationship management – use of technology • E-branding • Pricing – competitive • Retail markets – organised, competitive • Consumer – informed or ignorant??	8
	ETHICS	
1.	Ethics – a) Definiton of ethics, nature and scope of human values and ethics, Meaning of ethics b) Importance of ethics & moral standards, its relevance in social and professional life c) Great Personalities who are role models	4
2.	Ethical concepts: a) Concept of 'Right & Wrong' ; 'Good & Bad'; Difference between the two b) Concepts of Virtue and vice, Justice and fairness c) Individual, Society, Social groups, Institutions, Industry and Ethical norms – their relevance and	5

	relation (all these concepts to be discussed through case studies)	
3.	Practical ethics – **sociology perspective** a) Social ethics – ethics in business communication in a global market, legal aspects in communication and business observed and followed, b) Business ethics including moral and social responsibility of business organizations c) Consumer Behaviour and Society: Consumer rights, ethical advertising, consumer education, consumerism d) Ethics and values in R&D – Understanding critical importance of R&D, Plagiarism and legal remedies e) R&D and Intellectual Property Rights – critical role of IPRs in research management; avoidance of duplication, infringement, justification for placebos	7
4.	Medical Ethics; Code of Pharmaceutical ethics, Pharmacists Oath, Pharmacist and the patient	7
	List of Text Books/ Reference Books	
1	Giddens A., Sociology, 6th edition, Polity Press, 2009.	
2	Wagh M., Industrial Psychology And Sociology, 3rd edition, Career Publications.	
3	Dubos R., Man, Medicine and Environment, Mentor Books, 1969.	
4	Lillie W., An Introduction to Ethics, Delhi, 2007	
5	Satyanarayana Y.V, Medical Ethics Principles and Problems, Lambert Publications, 2013	
6	Sinha J, A manual of Ethics, New Central book agency, 1990	
7	Subramanian R., Professional Ethics, Oxford, New Delhi, 2013.	
	Course Outcomes (students will be able to)	
	SOCIOLOGY	
1.	Understand the importance of impact of individual behaviour on society	
2.	Learn the importance and implications of industrial democracy	
3.	Understand the role and impact of science and technology on industrialization	
4.	To provide students with an understanding of sociological theories and their relevance in personal and professional life.	
5.	To train students in the application of all theories to professional and social situations, understanding their impact and their ethical implications.	
	ETHICS	
1.	Understand and appreciate the value of ethical behaviour	
2.	Explain ethical concepts through contrasting ideas	
3.	Relate to ethics in society, business and professional life	

	Course Code:PHP1112	**Course Title: Pharmaceutics Laboratory – II**	**Credits = 2**		
			L	**T**	**P**
	Semester: III	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Pharmaceutics Laboratory – I				
List of Courses where this course will be prerequisite					
	Pharmaceutics/ Biopharmaceutics Laboratory – III, Dispensing Pharmacy Laboratory, Cosmeticology Laboratory				
Description of relevance of this course in the B. Pharmacy					
To train the students with respect to practical aspects of semisolid pharmaceutical formulation development and quality control of					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Representative examples of ointments (Preparation, packaging and evaluation)	12
2	Representative examples of creams (Preparation, packaging and evaluation)	12
3	Representative examples of gels(Preparation, packaging and evaluation)	12
4	Representative examples of paste and poultices (Preparation, packaging and evaluation)	12
5	Representative examples of suppositories (Preparation, packaging and evaluation)	12
Course Outcomes (students will be able to…..)		
1	Prepare, evaluate and label pharmacopoeial and non pharmacopoeial semisolid dosage forms	
2	Prepare, evaluate and label pharmacopoeial and non pharmacopoeial suppositories	
3	Propose type of container specific to product application	

	Course Code: PHP1204	**Course Title: Anatomy, Physiology & Pathophysiology Laboratory**	**Credits = 2**		
			L	**T**	**P**
	Semester: III	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	H.S.C (Biology)				
List of Courses where this course will be prerequisite					
	Pharmacology I, Pharmacology II, Pharmacology III, Pharmacology IV				
Description of relevance of this course in the B. Pharm. Program					
To train the students with respect to basics of pharmacopoeial monographs, basic principles of various physicochemical properties of the drug molecules and the drug metabolism pathways					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Red Blood Cell (RBC) Count	2*4
2	Total leukocyte Count	2*4
3	Differential Leukocyte (WBC) count	2*4
4	Hemoglobin content of blood	1*4
5	Bleeding time/Clotting time	1*4
6	Blood group/ESR/Measurement of blood pressure	1*4
7	Study of human skeleton	1*4
8	Microscopic study of permanent slides Tissues: - Columnar, Cuboidal, Squamous, CiliatedEpithelium - Cardiac/Skeletal/Smoothmuscle - Ovary, testis, Liver, Pancreas, Thyroid, Tongue, Stomach, Intestine, Kidney, Lung, Spinal Cord, Cerebrum, Artery, Vein	1*4
9	Discussion on some common investigational procedures used in diagnosis of diseases with the help ofcharts/ slides Name and Importance of following Tests: 1) Electroencephalogram(EEG) in diagnosis of epilepsy 2) Electrocardiagram(ECG) in diagnosis of cardiac arrhythmia 3) Liver Function tests- - Serum Bilirubin, Serum glutamate oxaloacetate transaminase(SGOT), Serum glutamate pyruvate transaminase (SGPT) - Urine Bilirubin, Urine Urobilinogen 4) Kidney Function Tests- - Serum Creatinine, Serum Urea, Uric acid, Serum Urea, Nitrogen (BUN) Blood Glucose - Serum Cholesterol/Triglycerides, Serum Alkaline phosphate (ALT), Serum Acid Phosphatase (APT) - Serum Lipase, Serum Amylase, SerumCalcium, SerumLactate dehydrogenase (LDH) 5) Thyroid Function tests- T3, T4	3*4
10	Diagnostic tests for infectious diseases like - Malaria, Tuberculosis, Dengue, Leptospirosis	1*4
List of Text Books/ Reference Books		
1	Praful B. Godkar, Textbook Of Medical LaboratoryTechnology 3rd edition, Bhalani Publishing House,	

	Mumbai, 2014	
2	V.G. Ranade, P.N. Joshi And Shalini Pradhan, A Textbook of Practical Physiology 4th edition, P.V.G. Prakashan, Pune-30, 1996	
3	G K Pal, Pravati Pal, Textbook of practical physiology, 3rd edition, 2011.	
4	C L Ghai, A Textbook of practical physiology,8th edition 2013.	
Course Outcomes (students will be able to…..)		
1	Evaluate and measure his/her own blood parameters. (HB/RBC/WBC/DLC/ESR/Clotting time/blood group/bleeding time)	
2	Identify the organs of the skeletal system	
3	Identify the cellular structure of the internal organs on the basis of histology	
4	Measure blood pressure, heart rate and pulse rate	
5	Read the blood report (hematology and some biochemical parameters related to liver, kidney and lipid profile)	
6	Understand ECG and EEG broadly	
7	Diagnose a disease condition (pertaining to Liver, Pancreas, Kidney,) based on the biochemical parameters	

	Course Code: BSP1302	**Course Title: Biochemistry Laboratory**	**Credits = 2**		
			L	**T**	**P**
	Semester: III	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Biochemistry				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the B. Pharm. Program					
To train the students for Qualitative and Quantitative estimation of carbohdrates , protein , vitamin, lipids and enzymes					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
1	Qualitative tests for Carbohydrates.		8		
2	Quantitative test for Carbohydrates Lane Eynon's Method WillstattersMethod DNS Method Folin- Wu Method (Blood Sugar)		8		
3	Qualitative tests for Amino acids, Proteins and Precipitation ofproteins		8		
4	Quantitativetests for Proteins Folin Lowery Method Biuret Method		8		
5	Enzymes Activity of Salivary Amylase Study of factors affecting rate of an enzymatic reactions: Determination of Optimum pH, Temperature, K_M, V_{Max}.		8		
6	Vitamins; Quantitativedeterminationof Vitamin C		4		
7	Lipids; Determination of acid value and iodine value oflipids.		8		
8	Estimation of RNA and Blood Cholesterol.		4		
9	Tutorials		4		
List of Text Books/Reference Books					
1	Plummer D.T., An Introduction to Practical Biochemistry. 2nd edition, McGraw Hill Book Co.,1978				
Course Outcomes (students will be able to…..)					
1	Describe the fundamental principle behind qualitative and quantitative estimation of proteins and carbohydrates				
2	Calculate the results and correlate the findings with physiological parameters				
3	Describe the fundamental principle behind qualitative and quantitative estimation of lipids and Cholesterol				

SECOND YEAR B.PHARM SEMESTER IV

	Course Code: PHT1407	**Course Title: Pharmaceutical and Medicinal Chemistry –I**	**Credits = 3**		
			L	**T**	**P**
	Semester: IV	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Organic Chemistry II, Anatomy, Physiology & Pathology-I				
List of Courses where this course will be prerequisite					
	Pharmaceutical and Medicinal Chemistry –II, Pharmaceutical and Medicinal Chemistry –III, Pharmaceutical and Medicinal Chemistry –IV, Pharmaceutical and Medicinal Chemistry –V				
Description of relevance of this course in the B. Pharm. Program					
To train the students with respect to basics ofpharmacopoeial monographs, basic principles of various physicochemical properties of the drug molecules and the drug metabolism pathways					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
1	**Introduction:** Study of monographs of official compounds in IP; Water – detail studyof water as universal pharmaceutical vehicle.		3		
2	Sources of contamination in pharmaceutical compounds (which are official inpharmacopeias).		2		
	Limit tests prescribed – e.g. chloride, sulphate, arsenic, lead, iron, nitrate, alkali &alkalineearthmetals		3		
3	Limits of – insoluble matter, solublematter, non-volatile matter, volatile matter, residue on ignition & ash value.		2		
4	Study of – major intracellular electrolytes & ions: chloride, phosphates, bicarbonate,Na, K, Ca, Mg (including their general, physiological properties and uses such as infusion fluids		3		
5	Study of essential and trace ions: Fe,Zn, Mn, Se, S and I- official compounds and uses		1		
6	Study of Gastrointestinal Agents: antacids, protectives and adsorbants, saline cathartics-official compounds		5		
7	Study of Topical Agents: protectives, antimicrobialsand astringents-officialCompounds		5		
8	Study of Important Inorganic Gases:oxygen, nitrogen, nitrous oxide, carbon dioxide,helium and ammonia		3		
9	Study of Expectorants		1		
10	Study of Inorganic Compounds: talc, barium sulphate, and other pharmaceutical aids.		2		
11	**Basic Principles of Medicinal Chemistry :** **Important Physicochemical properties of drug molecules and their influence on biological action:** Physicochemical properties of drug molecules: - Acid base properties; Solubility; Percent Ionization ; Drug distribution and pKa ; Partition coefficient		5		
12	Influence of Physicochemical properties of drug molecule on its distribution and biological action in the body: Oral administration: Prodrug approach ; Parenteral administration ; Protein binding ; Tissue depot ; Drug metabolism and excretion Drug receptor interaction – Introduction – Forces involved ; Steric factors influencing drug action including optical and geometric isomerism ; Isosterism		5		
13	**Drug metabolism Introduction:** Metabolism, First pass effect, General pathways of drug metabolism: Phase I and Phase II , Role of CYP 450 in Oxidative biotransformation Oxidative reactions: - Aromatic compounds - Aliphatic and alicyclic carbon atoms - Oxidation of alcohols and aldehydes Reductive reactions: - Reduction of Aldehyde and ketones - Reduction of nitro and azo compounds Hydrolytic reactions: - Hydrolysis of ester and amides Phase II (Conjugation reactions) - Glucuronic acid conjugation - Mercapturic acid conjugation - Acetylation - Methylation Factors affecting drug metabolism: - Age - Species / Strain - Genetics - Enzyme induction - Enzyme inhibition		5		
List of Text Books/ Reference Books					
1	J. H. Block, E. B. Roche, T. O. Soine, C. O. Wilson, Inorganic Medicinal and Pharmaceutical Chemistry, Varghese Publishing House, First Indian Reprint, 1986				
2	IP, BP,USP -Current-				
3	J. D. Lee, Concise Inorganic Chemistry, Oxford Blackwell Science, 5th edition 1996				
4	C.G. Wermuth, The Practice of Medicinal Chemistry, Academic Press, 3rd edition, 2008				

5	R. B. Silverman, The Organic Chemistry of Drug Design And Drug Action, Elsevier Publication 2nd edition, 2004	
Course Outcomes (students will be able to…..)		
1	Visualize the importance of monographs including source of impurities and limit tests	
2	Understand physiological importance of electrolytes, ions and trace elements	
3	Classify and understand mechanism of action of inorganic drugs	
4	Comprehend use of inorganic excipients and gases in drug manufacture/use	
5	Predict physicochemical properties of drug molecules and importance in ADME	
6	Predict reaction pathway in drug metabolism including active and toxic metabolites	

	Course Code: PHT1115	Dispensing Pharmacy & Hospital pharmacy	Credits = 3		
			L	T	P
	Semester: IV	Total contact hours: 45	2	1	0

List of Prerequisite Courses		
	Pharmaceutics: I & II	

List of Courses where this course will be prerequisite		
	NIL	

Description of relevance of this course in the B. Pharm (Pharmacy)

To train the students with respect to dispensing and compounding of different dosage forms and their role in hospital settings.

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
	DISPENSING PHARMACY	
1	Definition of Dispensing & Prescription, Parts of prescription, types of prescription, procedure, dispensing the prescription, refilled prescription, prescription pricing, and recording of prescription.	2
2	Calculations: Involved in compounding and Dispensing: Weight and measures, % calculations dilutions and concentrations, isotonic solutions HLB values.	5
3	Basic principles in dispensing: Types of dosage forms, formulation andStorage.	5
4	Containers and closures for dispensed products,labelling of dispensed products.	3
5	Dispensing of Solutions (oral external use, body cavities), Suspensions and Emulsions.	5
6	Dispensing of ointments, creams, gels, pastes, suppository and pessaries.	3
7	Powders & Granules, Lozenges, pastilles, pills, Tablets, capsules, Tablestriturates.	4
8	PrescriptionAccessories, Dispensing of Proprietary and Incompatibilities.	3
	HOSPITAL PHARMACY	
1	**Hospital**: Classification, Organization, Administration & Functions. **Hospital Pharmacy**: History, Development, Duties & responsibilities of Pharmacist.	2
2	Pharmacy & Therapeutic Committee, Hospital Formulary And Purchase: Procedure, Storage, Inventory Control.	3
3	Dispensign of Controlled Substances	1
4	**Bulk Compounding**: Large volume parentrals total parentral Nutrition,Intravenous additives.	1
5	**Central Sterile Service**: Advantages, Plan, Location, ActivitiesManagement.	1
6	**Sterilisation & Disposal of Surgical Materials**: Rubber gloves, Syringes, Needles, Catheters, Surgical Instruments, Powders, etc.	1
7	**Medical Gases**: Different gases &their uses, Colour coding of Cylinders & Care of Cylinders.	2
8	**Health Accessories**: Wheel chairs, Canes, Crutches, Bed panes, Syringes, Needles etc.	1
9	**Clinical Applications of Radiopharmaceuticals**: Therapeutic & Diagnosticradiopharmaceuticals.	1
10	**Application of Computers**:In maintenance of Records, Inventory control, Medication monitoring, Druginformation, etc.	1
11	Health Insurance	1

List of Text Books/ Reference Books

1	S.H. Merchamt & J.S. Quadry, A Text Book Of Hospital Pharmacy 3rdedition, Mr. S.B. Shah, 1989
2	A.R. Paradkar & S.A.Chunawala, Hospital & Clinical Pharmacy 9thedition, Nirali Publications , Pune, 1999Cooper & Guns. DispensingFor Pharmaceutical Students S.J. Carter 12thedition,1987 Pitman Books
3	S.J. Carter, Cooper & Guns. Dispensing for Pharmaceutical Students 12th edition, Pitman Books, 1987
4	W.Martin, Husa's Pharmaceutical Dispensing Eric 5thedition,Mack Publishing Company, 1971
5	Loyd V Allen, The Art,Science & Technology Of Pharmaceutical Compounding, 2ndedition, American Pharmaceutical Association, 2002
6	Mitchell J.Skotlosa, Howard C.Ansel, Pharmaceutical Calculations, 8th edition, Lea & Febiger, 1986
7	Rufus Lyman, American Pharmacy: Textbook Of Pharmaceutical Principles, Processes & Preparations, 4th edition, J.B.Lippincott Company, 1955
8	Diana M. Collett, & Michael E. Aulton, Pharmaceutical Practice, 1998, Churchill London
9	A.J. Winfield & R.M.E. Richards, Pharmaceutical Practice 2ndedition, 1998 Churchill Liningsto

Course Outcomes (students will be able to…..)

1	Understand prescription and principles of dispensing formulation.
2	Compound and dispense prescription formulation.
3	Basic understanding of prescription accessories, proprietary medicines and examine incompatibilities.
4	Practise pharmaceutical care and role of pharmacist in hospital setting and implement best practises of

	pharmacy in hospital setup.	

	Course Code: PHT 1209	**Course Title: Pharmacology I**	**Credits = 3**		
			L	**T**	**P**
	Semester: IV	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Human anatomy Physiology				
List of Courses where this course will be prerequisite					
	Medicinal Chemistry, Clinical Pharmacy, Drug regulatory affairs, Pharmaceutical technology				
Description of relevance of this course in the B. Tech./B. Pharm. Program					
Student will be able to understand therapeutic uses of different categories of drug, the prescription validity in case of polypharmacy, will be able to counsel lay people about the adverse effects of drugs and can apply this knowledge to medicinal chemistry, and pharmaceutical technology					

Sr. No.	**Course contents(topics/subtopics)**	**Reqd. hours**
1	General Principle of pharmacology: Routes of administration with special reference to their advantages and disadvantages. Drug ADME	7
2	Mechanismofdrugaction:Briefintroductionofphysiologicalreceptors-structural andfunctionalfamilies andcytoplasmicsecondmessengers	7
3	Drugreceptorinteraction, dose response relationship, drug antagonism	4
4	Factorsmodifyingtheactionsofdrugs;Drugtoxicityinhumans-toxiceffectsof drugsondifferentsystems,organsandtissue.Drugs used in thedisordersofgastro-intestinaltract:Emeticsandanti-emeticsandprokinetic drugs.Purgativesand anti-diarrheals,anti-spasmodics	6
5	Drugs usedinthetreatmentofhyperacidityandpeptic ulceration and anti-inflammatory bowel disease	4
6	Drugsaffectingbloodandbloodformingorgans:Drugseffectiveinvarioustypesof anaemias, anticoagulants, anti-thromobotics, thrombolytics.	7
7	Anti-diabeticand Anti-thyroid agents, Oxytocis, Oral contraceptive.	5
8	Discovery and Developmentofnewdrug:(Importanceofpreclinicalandclinicalstudies,phases of clinical trial and placebo)	3
9	Bioassay- Principles and applications of bioassay, Types of bioassay, Bioassay of insulin, oxytocin, vasopressin, ACTH,d-tubocurarine,digitalis, histamine and 5-HT	2

List of Text Books/ Reference Books	
1	Rang and Dale, Textbook of Pharmacology,8thedition, Elsevier, 2015
2	Tripathi K D., Essentials of Medical Pharmacology, 7thedition, Published by Jaypee brothers, 2013
3	Lippincott's Illustrated Reviews, Pharmacology 6thedition, Wolters Kluwer, 2015
4	R.S.Satoskar, S.D.Bhandarkar, Pharmacology and Pharmacotherapeutics 24th edition, 2015
5	F.S.K.Barar, Essentials of Pharmacotherapeutics 1st edition, S.Chand and Company Ltd, 2004
Course Outcomes (students will be able to.....)	
1	Understand principles of Pharmacology as well as Toxicology along with Pharmacokinetics and Pharmacodynamics.
2	Understand pharmacology of different drug categories like drugs acting on GIT in hypothyroidism, Antidiabetic, Antithyroid
3	Apply the knowledge to process of Drug Discovery.

	Course Code: PHT1306	**Course Title: Pharmaceutical Analysis-III**	**Credits = 4**		
			L	**T**	**P**
	Semester:IV	**Total contact hours: 60**	**3**	**1**	**0**
List of Prerequisite Courses					
	Pharmaceutical Analysis-I & II				
List of Courses where this course will be prerequisite					
	Pharmaceutics, Pharmacology, and Pharmaceutical chemistry, Biotechnology				

Description of relevance of this course in the B. Pharm. Program		
To train the students with respect to understand analytical method validation, chromatographic separation techniques, characterization techniques, modern hyphenated techniques and thermal analysis		
	Course Contents (Topics and subtopics)	**Reqd. hours**
1	**Analyticalmethodvalidation (asperUSPandICHguidelines):** Accuracy,Precision,Limitofdetection,Limitofquantification,Linearity, Range, Robustness, Ruggedness **Calibration of Analytical Instruments**	5
2	**Chromatography:** Terminologies-mobilephase,stationeryphase,normalphase,reversephase, isocraticelution,gradientelution,retentiontime,theoreticalplate,HETP, resolution;VanDeemer'sequation	5
3	Typesofchromatography-Adsorption chromatography,partitionchromatography,ion–exchangechromatography,ion-pairchromatography,affinitychromatography,sizeexclusionchromatography, paperchromatography;TLC-Rfvalue,factorsaffecting resolution in TLC, visualization techniques in TLC	5
4	**HPLC**: (Principleandinstrumentation-pumps,injectors, columns,detectors,autosamplers);Gas chromatography(Principleand instrumentation-typesofcolumns,detectors)	5
5	**Nuclearmagnetic ResonanceSpectroscopy(^{1}H NMRspectroscopy)**: Principle, precessionalfrequency,chemical shift,spin-spin coupling, coupling constant, briefinstrumentation; FT NMR	5
6	**Mass Spectroscopy:** Principle, methods of ionization-chemical ionization, FAB MS, thermospray, electrospray;Fragmentationpatterns-αfission, βfission, Mc Laffartyrearrangement, Retro Diel's Alder; Quadrupole mass spectrometer	5
7	**Hyphenatedtechniques:** GC-MS,LC-MS,LC-MS-MS, interfaces,advantages andlimitations	5
8	Structurallelucidationofsimpleorganiccompounds using:^{1}HNMR spectroscopy, mass spectroscopy, UVspectroscopyandIR spectroscopy	5
9	**Thermal analysis:** Thermogravimetric analysis (TGA); Differential Scanning Calorimetry (DSC): Principle and pharmaceutical applications, polymorphism.	5
10	**Atomicabsorptionspectroscopy:** Principle instrumentation and pharmaceutical application	5
11	**Atomicemissionspectroscopy (Flamephotometry) :** Principle instrumentation and pharmaceutical applications	3
12	**Statistical methods:** Statisticsandstatisticalqualitycontrol:Statisticsinqualitycontrol–definitionof terms,normaldistribution,T-test,F-test, linear regression, correlation coefficient, statistical validation of analytical procedures – application to analysis; Methods of statisticalanalysis asappliedtosamplingandinterpretationof results, regressionlines– samplingprocedures;Statisticalqualitycontrolcharts;Case studies to be included.	5
13.	**Miscellaneous: Radio immune assay, X-Ray Diffraction**	**2**
List of Text Books/ Reference Books		
1	Beckett, A.H & Stenlake, J.B, Practical pharmaceutical chemistry, 4thEdn. (Part II), CBSPublishers& Distributors, India, 1988.	
2	Lee D.C & Webb M.L, Pharmaceutical analysis, Wiley-Blackwell, 2009.	
3	Christian, G.D, Analytical chemistry, 6thedition, John Wiley & Sons. New York, 2003.	
4	Mendham, J., Denney R.C., Barnes J. D. and Thomas M.J.K., Vogel's Textbook of quantitative chemical analysis, 6thedn, Prentice Hall, 2000.	
5	Svehla, G, Vogel's qualitative inorganic analysis, 7th edition, Prentice Hall, 1996.	
6	Pavia D.L., Gary M.L., George S.K. and James. A.V.,Introduction to Spectroscopy, Wadsworth Publishing Co Inc; 4thedition, 2008	
7	Skoog and West, Principlesof Instrumental Analysis, 4thedition, Saunders College Publishing,USA, 1992.	
8	WillardH.H.L. L. Merrit & John A., Instrumental Method of Analysis, 6thedition,CBS Publishers & Distributors, New Delhi, 1986.	
9	William Kemp, Organic Spectroscopy, 3rdedition, Reprinted, Palgrave Publishers Ltd., New York, 2005	
10	Indian Pharmacopoeia	
11	British pharmacopoeia	
12	United States pharmacopoeia	
Course Outcomes (students will be able to…..)		

1	Describe validation of analyticalmethods as per ICHand industry guidelines, statistical quality control
2	Do structure elucidation of organic molecules
3	Describe identification&quantitativeanalysisofAPIs,relatedsubstances
4	Suggest suitable method ofanalysis in various phases of drugdevelopment
5	Enumerate Isolation, purification & characterization of molecules of synthetic &natural origin

	Course Code: BST1202	**Course Title: Microbiology**	**Credits = 3**		
			L	**T**	**P**
	Semester: IV	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Science (Any combination of Physics, Chemistry, Maths and Biology) in Std 12				
List of Courses where this course will be prerequisite					
	Microbiology and Biotechnology laboratory				
Description of relevance of this course in the B. Tech./B.Pharm. Program					
To familiarize students with history and application of microorganisms in pharmaceutical field; morphology, cultivation, growth, economic significance of different microorganisms; different types of microscopic and staining techniques to study microorganisms; methodologies to obtain pure culture, cultivation and maintenance of different microorganisms and basic aspects of immunology					
Sr. No.	**Course contents (Topics and subtopics)**		**Reqd. hours**		
1	**History**: (Louis Pasteur's contribution (Koch Postulates)		1		
2	**Application of Microbiology in the field of pharmacy**: (Antibiotics, vaccine production, pathogenic organisms etc),		5		
3	**Different types of microscopes**: (dark, Fluorescence, atomic force, scanning tunnel, confocal etc)		4		
4	**Different types of staining techniques (with reference to bacteria)**: Monochromatic and differential staining (Gram staining, Acid fast staining, Capsule, flagella spore, cell wall staining, Negative staining)		3		
5	Prokaryotes and Eukaryotes, Classification of microorganisms as bacteria, yeast, mould, virus, rickettsiae, algae, protozoa		3		
6	Isolation and identification of pure cultures of bacteria, Culture media such as cultivation, storage media, enrichment media, differential, media and microbiological assay media,		4		
7	**Sterilization**: Different methods of sterilization; Aseptic techniques, Disinfection and disinfectants		3		
8	**Bacteria**: * Morphology, Cell characteristics, habitat, nutrition, reproduction, cultivation, Growth phases of bacteria, measurement of growth, factors affecting growth,		5		
9	**Virus**: * Morphological characteristics, Cultivation of viruses, Reproduction, Oncogenic and HIV viruses		3		
10	**Yeasts / Molds**: * Morphology, habitat, nutrition, Reproduction in yeast, molds of Clinical significance		3		
11	**Algae**: * Morphology habitat, Economic significance of algae		2		
12	**Protozoa**: * Morphology, Clinical significance of protozoa		2		
13	**Rickettsiae**: * Morphology , Diseases caused by rickettsiae		2		
14	Introduction to immunology		5		
List of Text Books/Reference Books					
1	Pelczar, Michael J., E. C. N. Chan, and Noel R. Krieg. Microbiology. 5th edition,Tata Mc-Graw Hill, 1993				
2	McNeil, Brian, and Linda M. Harvey. Practical fermentation technology. Chichester: Wiley, 2008.				
3	Frobisher, Fundamentals of Microbiology, 10thedition, 2014				
4	Pharmacopoeias: IP,BP,USP,EP				
Course Outcomes (students will be able to)					
1	Know and explain the history and application of diverse microorganisms in pharmaceutics				
2	Know and explain morphology, cultivation methods for diversity of microorganisms, their physiology and metabolism				

3	Apply microscopy and staining techniques to study and differentiate different microorganisms.	
4	Know and apply the basic methodologies to obtain microbes in their pure form	
5	Understand and elucidate the basic immune system against invading pathogens	

	Course Code: CHP1102	**Course Title: Organic Chemistry Laboratory-II**	**Credits = 2**		
			L	**T**	**P**
	Semester: IV	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Organic Chemistry Laboratory I				
List of Courses where this course will be prerequisite					
	All the Pharmaceutical Chemistry and Medicinal Chemistry Practicals				
Description of relevance of this course in the B. Pharm. Program					
To train the students in classical separation techniques for binary organic mixtures					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
1	a) Principles of qualitative separation of organic mixtures using physical properties, chemical properties and their combination b) Principles of quantitative separation of organic mixtures using physical properties, chemical properties and their combination		4 4		
2	a) Separation of solid-solid water insoluble binary organic mixtures b) Separation of solid-solid partly water soluble binary organic mixtures c) Separation of solid-solid mixtures by fractional crystallization d) Separation of liquid-liquid mixtures by distillation e) Separation of liquid-liquid mixtures by solvent extraction		5*4 2*4 2*4 2*4 2*4		
List of Text Books/ Reference Books					
1	Arthur, Vogel. Textbook of practical organic chemistry, 5th edition, publishers Longman group Ltd, 1989				
2	F.G. Mann and B.C. Saunders, Practical Organic Chemistry, 4thedition publishedby OrientLongman				
3	Keese, R, Martin P. B, and Trevor P. Toube. Practical organic synthesis: a student's guide. John Wiley & Sons, 2006.				
Course Outcomes (students will be able to…..)					
1	Work safely in the organic chemistry laboratory				
2	Separate binary organic mixtures by multiple techniques				
3	Understand basic principles for separation of binary organic mixtures qualitatively and quantitatively				

	Course Code:PHP1113	**CourseTitle: Dispensing Pharmacy Laboratory**	**Credits = 2**		
			L	**T**	**P**
	Semester: IV	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Pharmaceutics Laboratory – I, Pharmaceutics Laboratory – II				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the B. Pharmacy					
To train the students with respect to practical aspects of dispensing pharmacy and quality control thereof					
Sr.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		

No.		
1	Representative examples of solutions (oral, external use, body cavities) suspensions & emulsions (Compounding and dispensing, packaging and evaluation)	8
2	Representative examples of ointments, creams, gels, pastes (Compounding and dispensing, packaging and evaluation)	8
3	Representative examples of suppository & pessaries (Compounding and dispensing, packaging and evaluation)	8
4	Representative examples of powders & Granules (Compounding and dispensing, packaging and evaluation)	12
5	Representative examples of Lozenges, pastilles, pills (Compounding and dispensing, packaging and evaluation)	8
6	Representative examples of tablets, and tables triturates. (Compounding and dispensing, packaging and evaluation)	8
7	Representative examples of capsules (Compounding and dispensing, packaging and evaluation)	8
Course Outcomes (students will be able to…..)		
1	Read and understand prescriptions	
2	Prepare the products as per prescription requirement	
3	Design appropriate label	
4	Dispense the prescription in appropriate package	

	Course Code: PHP1305	**Course Title: Pharmaceutical Analysis Laboratory-II**	**Credits = 2**		
			L	**T**	**P**
	Semester: IV	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Analysis Laboratory –I				
List of Courses where this course will be prerequisite					
	Pharmaceutics, Pharmacology, and Pharmacognosy, PharmaceuticalAnalysis-II, PharmaceuticalAnalysis-III				
Description of relevance of this course in the B. Pharm. Program					
To train the students with respect to Spectroscopic method and other physical methods of analysis					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	Atomic absorption spectroscopy / flame photometry(Alkali earth metal determinations), DSC,TGA Demonstration	4
2	NMR, Mass Spectroscopy, GCMS, HPLC Demonstration	4
3	NMR, Mass Spectroscopy problem solving from recorded spectra	4
4	Absorption spectroscopy (UV, Visible), nephelo turbidometry;includingeffect of solvents on absorptionmaxima of organic compounds	12
5	Fluorescence spectroscopy (Quinine salt), Quenching phenomenon.	8
6	Chromatography (PC, CC, TLC) application to reaction monitoring, purity assessment of drugs, separation of the mixtures.	8
7	Medicaments in formulations: Liquid oral, tablet, injectable,aerosol, capsule, ointment, eye drops, suppositories, lozenges, etc. (one each);	4
8	Multi component analysisfordrugsincombination. eg: Using simultaneous equation method, using iso absorption point method, Using solvent extraction method, Using colorimetric and UV methods.	8
9	Refractometry Calibration of Abbe's Refractometer, Estimation of refractive index of natural oils and laboratory solvents, determination of the percentageof glycerin in the unknown by calibration curve.	4
10	Polarimetry Instrument information, Optical rotation of dextrose solution, determination of specific optical rotation of ethambutol,	4
List of Text Books/ Reference Books		
1.	Indian Pharmacopoeia	
2.	United States pharmacopoeia	

3.	British pharmacopoeia	
Course Outcomes (students will be able to…..)		
1	Prepare sample for analysis form bulk	
2	Decide proper mobile phase and separate / resolve the mixture of compounds	
3	Analyse the drugs in single and multicomponent formulations using various techniques such as UV, IR, NMR, Mass	
4	Apply the techniques like Refractometry and Polarimetry to known and unknown pharmaceutical samples	
5	Apply all above the concept to an unknown sample	

	Course Code:IPP1102	**Course Title: Computer Laboratory**	**Credits = 2**		
			L	**T**	**P**
	Semester: IV	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Nil				
List of Courses where this course will be prerequisite					
	Nil				
Description of relevance of this course in the B. Pharmacy					
To train the students with respect to use of computer and various applied softawares related to pharmaceutical sciences and technology					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
1	MS office Excel: Statistical analysis and data treatment		8		
2	Graph pad prism, statistica: Statistical analysis and data treatment		10		
3	MS office Power point: Basics and advances		8		
4	Basics of Matlab, Chemsketch, Chemdraw		10		
5	Basics AOT, Epidog, X-pharmacology, QSPR, Kinetica		10		
6	Introduction to softwares used for scientific referencing		4		
8	C/C++ programming: Basics, arrays, loops, if-else, switch case, functions, pointers, classes; Solving set of linear equations (dissolution etc.)		10		
Course Outcomes (students will be able to…..)					
1	Hands on training on use of computer and various softwares				
2	Application of software knowledge in regular course work				

THIRD YEAR B.PHARM SEMESTER V

	Course Code: PHT1408	**Course Title: Pharmaceutical and Medicinal Chemistry –II**	**Credits = 3**		
			L	**T**	**P**
	Semester: V	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Pharmaceutical and Medicinal Chemistry I				
List of Courses where this course will be prerequisite					
	Pharmaceutical and Medicinal Chemistry III, Pharmaceutical and Medicinal Chemistry IV, Pharmaceutical and Medicinal Chemistry V				
Description of relevance of this course in the B. Pharm. Program					
To train the students with respect to basics of anti-infective, anti-cancer and anti-viral drugs					

	Course Contents (Topics and subtopics)	**Reqd. hours**
	Chemotherapeuticagents: Studyofthefollowingclassesofdrugswithrespectto theirclassification,chemicalnomenclature, structure including stereochemistry, generic names, chemistry, physicochemical properties, SAR, metabolism,molecularmechanismofactionandsynthesisandintroductiontorationaldevelopment, if any.	
1	**Antibacterial agents –**	
	Antibiotics: beta-lactam antibiotics including-penicillin, cephalosporins, carbapenems, monobactams; Tetracyclincs and glycylcyclins.	5
	Other antibiotics: Marcolides and ketolides, Aminoglcosides, Miscellaneous includingchloramphenicol, vancomycin, bacitracin etc.	3
	Synthetic antibacterials: Sulfonamides and DHFR inhibitors, Quinolones, Oxazolidinediones and other miscellaneous agents.	5
2	**Anitparasitic agents-** a) Antiamoebics, b) Antimalarials, c)Anthelmintics d) Miscellaneous including drugs versusTrypanosomiasis, leishmaniasis, scabies, filaria etc	4
3	**Antifungalagents-** a) Azoles, b) Polyene antibiotics and Miscellaneous including Allyl amines, Tolnaftate, griseofulvinetc.	3
4	**Antimycobacterialagents-** a) Antitubercular agents b) Antileprotic agents Drugs versus MAC	3
5	**Anticancer agents –** a) DNA alkylating agent b) Nitrosoureas Procarbazines, Triazines and misc. Organoplatinumagents c) Antibiotics d) Antimetabolites including DNA polymerase inhibitors, Pyrimidine and purine antagonists and misc. agents. e) Mitosis inhibitors and other misc. anticancer agents.	5
6	**Antiviral agents –** a) General aspects b) Agents interfering with nucleic acid replication including those with modification with bases sugars and phosphate. c) Amantidine and its analogs, interferon and its inductors. Nuraminidase inhibitors d) Antiretroviral drugs including NRTI, NNRTI and protease inhibitors.	5
	Studyofthefollowingclassesofdrugswithrespecttotheirclassification,chemicalnomenclature, structure including stereochemistry, generic names, chemistry, physicochemical properties, SAR, metabolism,molecularmechanismofactionandsynthesisandintroductiontorationaldevelopment, if any.	
7	**Non Steroidal Anti-inflammatory Agents:** Antipyretic analgesics, Salicylates**,** Aryl alkanoic acids, N-aryl anthranillic acids**,** Oxicams**,** Selective COX-2 inhibitors	5
8	**Antihistaminic agents:** H_1antagonists- Classical antagonists & Non-sedative H_1antagonists	2
9	**Antiulcer agents:** H2 antagonists, Proton Pump inhibitors etc	3
10.	**Local anesthetics**	2

List of Text Books/ Reference Books		
1	Foye, William O. Foye's principles of medicinal chemistry. Edited by Thomas L. Lemke, and David A. Williams, 6thedition, Lippincott Williams & Wilkins, 2008.	
2	Wilson, Charles Owens, and Ole Gisvold, Textbook Of Medicinal And Pharmaceutical Chemistry, 11thedition, Lippincott Williams & Wilkins, Philadelphia, 2004	
3	Donald J. Abraham, David P. Rotella, Burger's Medicinal Chemistry, Drug Discovery and Development, 7th edition, 8 Volume Set, John Wiley & Sons-New Jersey,2010	
4	Remington, Joseph Price. Remington: The science and practice of pharmacy. Edited by David B. Troy, and Paul Beringer. Vol. 1. Lippincott Williams & Wilkins, 2006.	
5	Iyer R. P, Degani M. S., Synthesis Of Drugs: A Synthon Approach, 2nd edition, Vol-1, Sevak Publications Pvt. Ltd., 2008	
6	Axel Kleemann and Jürgen Engel, Pharmaceutical Substances: Synthesis, Patents, Applications (N-Z) Kleemann 4th edition, Thieme, 2011	
7	Lednicer, Daniel. The organic chemistry of drug synthesis. Vol. 7. John Wiley & Sons, 2007.	
8	R. B. Silverman & Holladay, The Organic Chemistry of Drug Design And Drug Action. 3rd edition, Elsevier Publication, 2014	
Course Outcomes (students will be able to…..)		
1	To classify and understand structures and write IUPAC names of structures (includes 3D structures)	
2	Understand drug mechanism at molecular level	
3	Understand and apply the concepts of SAR	
4	Predict synthetic routes for some of the drugs studied for above class.	

	Course Code: PHT1116	**Course Title: Biopharmaceutics and Pharmacokinetics**	**Credits = 3**		
			L	**T**	**P**
	Semester: V	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Pharmaceutics III				
List of Courses where this course will be prerequisite					
	Pharmaceutics IV				
Description of relevance of this course in the B.Pharmacy					
To train the students with respect to basics and applications of biopharmaceutics and pharmacokinetics					
	Course Contents (Topics and subtopics)		**Reqd. hours**		
1	Introduction: Definition:absorption,distribution, metabolism,excretion,elimination, first pass effect, enterohepatic cycling, bioavailability, biopharmaceutics, pharmacokinetics and pharmacodynamics		3		
2	Pharmacokinetics parameters: biological half life, volume of distribution,clearance: renal clearance, nonrenal clearance, additively of clearance, absolute bioavailability relative bioavailability, bioequivalence, and other parameters		3		
3	Concepts of compartment models: Pharmacokinetics of one compartment model, mathematical treatment to pharmacokinetics upon i.v. bolus dosing, i.v. infusion and first order extra vascular input		5		
4	Methods of estimation of pharmacokinetic parameters and parameters for bioavailability/ bioequivalence – including method of residuals, excretion rate method, and sigma minus method of estimationof renal clearance, renal clearance, mean residence time; Wagner Nelson method		5		
5	Multi-compartment models:Conceptsand examples (excluding derivation ormathematical treatment)		3		
6	Plasma concentration and therapeutic response and introduction topharmacodynamics;		2		
7	Non-linear pharmacokinetics: Non-linearities in absorption distribution,metabolismand elimination, examples of drug showing nonlinear pharmacokinetics		3		
8	Dosage regimens: Factors affecting dosage regimens, individualization of dosage regiments, therapeutic window, multipledose pharmacokinetics, fluctuation, accumulation index, steady state concept, timeto reach steady state, loading dose, maintenance dose, dose requiring individuation of dosage regimens		4		
9	Drug absorption: Different mechanism of drug transport, passive transport and pH partition theory,		5		

	facilitated diffusion, active transport, bloodand its drug binding constituents as carriers ofdrugs in the body; Perfusion limitation and permeability limitation and permeability limitationindrug transport; Physicochemical and physiological factors affecting the absorption of drugs	
10	Distribution:rate of distribution, perfusion limitation and permeability limitation, extent of distribution , plasma and tissue binding of drugs, drugs with small, intermediate and high volume of distribution and their relative plasma and tissue binding	4
11	Elimination: Organ clearance concepts,hepatic clearance, hepatic extraction ratio, blood flow limitation in hepatic clearance, first pass effect; Clinical application : Effect of enzyme induction, enzyme inhibition, blood flow and protein binding on hepatic clearance, bioavailability, steadystate plasma concentration and dosage regimens, renal clearance and mechanismsof renal excretion, estimation of renal clearance, factors affecting renal elimination, clinical applications, biliary clearance, enterohepatic circulationand other miscellaneous modes of drug elimination	5
12	Invitro Invivo correlation, official and unofficial methods of dissolution, invitro release of drugs from dosage forms; invitro-invivo correlation and its significance	3
List of Text Books/Reference Books		
1	D.M. Brahmankar, Sunil B. Jaiswal, Biopharmaceutics &Pharmacokinetics-A Treatise 1st edition, Vallabh Prakashan, 1955	
2	Robert E. Notari, Biopharmaceutics &Clinical Pharmacokinetics-An Introduction 4th edition, Marcel Dekker Inc, 1971	
3	Malcolm Rowland Thomas N. Tozer, Clinical Pharmcokinetics- Concepts & Applications 2nd edition, Lea & Febiger,Philadelphia, 1989	
4	Milo Gibaldi, Biopharmaceutics &Clinical Pharmacokinetics 3rd edition, Lea Febiger, Philadelphia, 1984	
5	Leon Shargel, Pharmacy Review, Wiley Medical Publication, 1990	
6	Dr.H.P.Tipnis Dr.Amrita Bajaj, Principles & Applications of Biopharmaceutics &	
7	Pharmacokinetics, Career Publication, 2004	
Course Outcomes (students will be able to…..)		
1	Know fundamentals of Biopharmaceutics and Pharmacokinetics	
2	Describe the basic terminology used in Biopharmaceutics and Pharmacokinetics.	
3	Equate different processes occurring in the body after the drug administration.	
4	Compute various Pharmacokinetic parameters.	
5	Effectively select dosage form for the treatment of diseases.	

	Course Code:PHT1117	**Course Title: Cosmeticology**	**Credits = 3**		
			L	**T**	**P**
	Semester: V	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Pharmaceutics –I, Pharmaceutics-II, Pharmaceutics-III				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the B. Pharmacy					
To train the students with respect to basics and advances of Cosmetic products.					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
1	**Introduction to Cosmetics and basic consideration:** • Definition of cosmetics; historicalbackground, classification of cosmetics and primary functions • Toxicology of cosmetics- irritation and sensitization reactions to cosmetics, tests to predict such reactions and regulatory guidelines for cosmetics • Microbial contamination in cosmetics; Perfumes, colours and other raw material used in cosmetics- a brief review		5		
2	**Skincarecosmetics:** • Anatomy of skin and appendages. Need, role and effect of cosmetic preparations. • Types of skin cosmetics [skin creams and lotions- cold creams, vanishing creams, bleach creams,		6		

	acne creams, hand and body creams and lotions (barrier preparations), emollient creams, insect repellants, face powder, lipstick, rouge, face packs- cleansing preparations- moisturizers, bath oils etc.] • Discussion on each type of skin cosmetic w.r.t. excipients, formulation, equipments used, large scale manufacture, packaging, quality control tests • Advances in Skin c a r e cosmetics	
3	**Sunscreen products- sun tan and anti sunburn products** • Introduction to concept of sunscreens, sun tan, SPF calculation etc • Excipients, formulation, equipments used, large scale manufacture, packaging, quality control tests • Advances in sunscreen cosmetics	2
4	**Hair care cosmetics :** • Anatomy of hair. Need, role and effect of cosmetic preparations. • Types of hair care cosmetics [shampoos, women's hair dressings, men's hair dressings, hair tonics, hair conditioners, hair rinses, hair colorants, hair waving and straightening preparations, depilatories, shaving preparations and aids (after shave solution/ lotion/ cream), anti-lice preparations etc.] • Discussion on each type of hair care cosmetic w.r.t. excipients, formulation, equipments used, large scale manufacture, packaging, quality control tests • Advances in hair care cosmetics	6
5	**Nail care cosmetics:** • Anatomy of nail. Need, role and effect of cosmetic preparations. • Types of nail care cosmetics [pedicureandmanicurepreparations(nail polish, nail paint removers, cuticle removers, nail whiteners etc.] • Discussion on each type of nail care cosmetic w.r.t. excipients, formulation, equipments used, large scale manufacture, packaging, quality control tests • Advances in nail care cosmetics	6
6	**Dental care products:** • Anatomy of tooth. Need, role and effect of dental care products. • Types of dental care products[toothpaste, tooth powder, mouth washes and denture cleansers etc.] • Discussion on each type of dental care w.r.t. excipients, formulation, equipments used, large scale manufacture, packaging, quality control tests • Advances in dental care products	6
7	**Eye makeup products:** • Anatomy of eye. Need, role and effect of eye makeup products • Types of eye makeup products [eye shadow, eye liner, mascara etc.] • Discussion on each type of eye makeup product w.r.t. excipients, formulation, equipments used, large scale manufacture, packaging, quality control tests • Advances in dental makeup products	6
8	Introduction to baby cosmetics with specific examples in Skin, hair, dentalcarecosmetics	4
9	Introduction to herbal cosmetics Skin, hair, dental, nail eyecarecosmetics	4
	List of Text Books/ Reference Books	
1	Howard C. Ansel, Nicholas G. Popovich, Lord V. Alien, Pharmaceutical Dosage Form And Drug DeliverySystems, 6th edition, B.I.WaverlyPvt.Ltd.,New Delhi, 1995	
2	Rieger, Harry's Cosmeticology8th edition, Leonard Hill Book &Intertext Publisher, London, 2000	
3	M.M. Breuer, Cosmetic Science (Vol 2), Academic Press, London, 1978	
4	P.P. Sharma, Cosmetics: Formulation, Manufacturing & Quality Control, Vandana Publications, New Delhi, 1988	
5	Michael & Irene Ash, A Formulary Of Cosmetic Preparations 1st edition, George Godwin Ltd., London, 1977	
	Course Outcomes (students will be able to…..)	
1	Discuss the importance of cosmetics with reference to functions, regulatory requirements and toxicology.	
2	Explain the formulation considerations, types of skin care and hair care cosmetics and evaluation thereof	
3	Explain the formulation considerations, types of nail cosmetics, teeth cosmetics and evaluation thereof	
4	Describe considerations for formulation development of baby and herbal cosmetics	

	Course Code: PHT 1210	**Course Title: Pharmacology-II**	**Credits = 3**		
			L	**T**	**P**

	Semester: V	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Pharmacology I				
List of Courses where this course will be prerequisite					
	Pharmacology III				
Description of relevance of this course in the B.Pharm. Program					
To train the students with the basics of Chemotherapy					

	Course contents (Topics and subtopics)	Reqd. hours
1	Chemotherapy: Basic concepts and general principles	3
2	Antibiotics and Principles of antibacterial	3
3	Chemotherapy of Sulfonamides – Trimethoprim	3
4	Quinolones and fluroquinolones	3
5	Penicillins and Cephalosporins	5
6	Macrolides, Tetracyclines, Chloramphenicols	5
7	Antifungal agents	3
8	Antiviral agents	5
9	Anticancer agents	7
10	Chemotherapy of Parasitic diseases, Amoebiasis, Antimalarial, Anthelmentics	5
11	Chemotherapy of Tuberculosis/Leprosy	3

List of Text Books/Reference Books	
1	Rang and Dale, Textbook of Pharmacology,8thedition, Elsevier, 2015
2	Tripathi K D., Essentials of Medical Pharmacology, 7thedition, Published by Jaypee brothers, 2013
3	Lippincott's Illustrated Reviews, Pharmacology 6th edition, Wolters Kluwer, 2015
4	R.S.Satoskar, S.D.Bhandarkar, Pharmacology and Pharmacotherapeutics 24th Edition, 2015
5	F.S.K.Barar, Essentials of Pharmacotherapeutics 1st edition, S.Chand and Company Ltd, 2004

Course Outcomes (students will be able to)	
1	Understand basic concepts and general principles of antibiotics, antibacterials, chemotherapy and sulfonamides.
2	Understand concepts and principles of Quinolones, fluoroquinolones, penicillins, cephalosporins, macrolides, tetracyclins, chloramphenicols and antifungal agents.
3	Understand concepts of antiviral agents, anticancer agents, chemotherapy of parasitic diseases, amoebiasis, Antimalarial, anthelmintics and chemotherapy of tuberculosis and leprosy.

	Course Code: BST1203	Course Title: Molecular Biology and Biotechnology	Credits = 3		
			L	T	P
	Semester: V	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	10th std. Biology; 12th std Chemistry				
List of Courses where this course will be prerequisite					
	Applied Molecular Biotechnology				
Description of relevance of this course in the B. Tech./B.Pharm. Program					
To familiarize students with the genetic tools available to express heterologous proteins in prokaryotic and eukaryotic model host organisms					

Sr. No.	Course contents (Topics and subtopics)	Reqd. hours
1	**DNA replication and transcription**	5
2	**Protein biosynthesis**	5
3	**Recombinant DNA technology:** Tools of rDNA technology, Restriction endonucleases, DNA modifying enzymes Generation of a recombinant fragment plasmid cloning vectors, creating and screening a library, cloning DNA sequences that encode eukaryotic proteins, Vectors for cloning large pieces of DNA, genetic transformation of prokaryotes	5 3 2

4	**Manipulation of gene expression in prokaryotes:** Expression vectors, gene expression from strong and regulatable promoters Fusion proteins, expression vectors Increasing protein stability and secretion of proteins, DNA introduction and integration into the host genome	5 2 3
5	**Heterologous protein production in eukaryotic cells:** Post-translational modification of eukaryotic proteins, general features of eukaryotic expression systems, yeast- and filamentous fungus-based expression systems, baculovirus-insect cell expression systems, mammalian cell expression systems	5
6	**Bioinformatics:** Molecular databases, gene and protein analysis tools, protein modeling	5
7	**Introduction to synthetic biology for biomanufacturing**	5
List of Text Books/Reference Books		
1	Glick and Paternak, Molecular Biotechnology: Principles and Applications of Recombinant DNA, 3rd edition, ASM Press, 2003	
2	R.W. Old, S.B. Primrose, Principles of gene manipulation : An introduction to genetic engineering, 5th Edition, Blackwell Scientific, 1994	
3	T A Brown, Gene Cloning and DNA Analysis: An Introduction, 7th edition, Wiley-Blackwell, 2015	
Course Outcomes (students will be able to)		
1	Choose gene cloning strategies to express heterologous proteins	
2	Analyze vector sequences and determine their functional characteristics	
3	Explain and employ the techniques used to transfer genetic elements in animal cells	

	Course Code: PHT1118	Course Title: Forensic Pharmacy and Drug Store Management	Credits = 4		
			L	T	P
	Semester: V	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	-				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the B.Pharm					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
	Forensic Pharmacy	
1	Status of profession of pharmacy in pre and post-independence era; reports of Chopra inquiry committee; Health and berker committee and action thereon	3
2	Historical perspectives; an objective study of the following with amendments: Drugs and cosmetic act 1940/ rules 1945-events, commencement-important definitions – drugs technical advisory board and central drug laboratory- their compositions and functions	8
3	Ayurvedic and allopathic drugs, prohibitions – ayurvedic Homeopathic and allopathic medicines in respect of import and export, indigeneous manufacture, sales of distribution	5
4	Drugs consultative committee, its compositions and functions; Inspectors –their powers and duites; Sampling procedures; Inspection enquiry: Investigation and prosecution	3
5	Standards (allopathic drugs/Cosmetics/Ayurvedic drugs); Imported drugs, cosmetics, and indigenously manufactured drugs, and analyst; Licensing authorities and controlling authorities- qualifications, functions and powers; Licenses for different systems of medicines	3
6	Drugs and magic remedies Act 1954- definitions, official's duties prohibitions, penalties; Narcotic Drugs and Psychotropic Substances Act 1985- Historical backgrounds of Opium Act and Dangerous Drugs Act, prohibitions and penalties; Preservation of food Adulteration Act 1954 and rules 1955	5
7	Important definitions, central board of food standards central food laboratoty- compostions and functions; Public analyst –qualifications,duties; Food inspectors-qualification, powers duties sampling procedures	2
8	Drug price control order 1987-historical background –Essential Commodities Act – relevant provisions, Drug prices display Rule 1961-and other relevant orders – applicability to imported drugs and indigenously manufactured drugs, definitions, prices to wholesaler and retailer, MAP-penal provisions	3
9	Pharmacy Act 1948; Poisons Act 1919 and Maharashtra Poisons Rules 1972 and amendment 1976; Medicinal and Toilet preparations (Excise duties) Act 1955; Pharmaceutical committees with details of Chopra, Hathi and Berker committees; Bombay shop and Establishment Act; Insecticides Act 1968 and Rules thereunder- Licensing system; Factories Act – Licensing system- precautions, suggestion under act; Criminal procedure code and Indian penal code- provisions pertaining to different courts, Jurisdiction and power, Punishments available, Types of trials e.g. summary trials; Other procedures- warrants, summons; Provisions governing entry, arrest, search, seizere; Types of offences- bailable, nonbailabel, cognisable and noncognisable	5
10	Consumers protection Act with reference to provisions applicable to drug manufacture and sale	2
11	Patents and laws relating to Intellectual Property Rights.	2
	Drug Store Management	
1	Introduction to Retail (Community) Pharmacy as a Career. 1. Retail Pharmacy Origin and Concept 2. Pharmacy as Profession 3. Role of Retail (Community) Pharmacist	2
2	Retailing:SingleStore(ModelPharmacy),DepartmentalStores,Malls, Chain Stores, Co-operative Pharmacy and Internet Pharmacy	3
3	FormsofBusinessOrganizations-SoleProprietorship,Partnership,andCorporate Structure including Co-operative Societies	3
4	Building of a Model Pharmacy	3
5	Stocking / Inventory Control and Recordkeeping	2
6	Sales Promotion Methods	2
7	Banking and finance	2
8	Prevention of Frauds and Risk insurance	2
List of Text Books/ Reference Books		

1	N. K. Jain, Textbook of Forensic Pharmacy, 8th edition Vallabh Prakashan	
2	C.K. Kokate, S.B. Gokhale, Textbook of Forensic Pharmacy 2nd Edition Pharma Book Syndicate	
3	Dr. B. S. Kuchekar A. M. Khadatare Sachin Itkar, Forensic Pharmacy 7th edition Nirali Prakashan	
4	Deshpande S. W, Drugs & Cosmetics Act, 4th Edition	
5	S.H. Merchamt & J.S. Quadry, A Text Book Of Hospital Pharmacy 3rd edition, Mr. S.B. Shah, 1989	
6	A.R. Paradkar & S.A.Chunawala, Hospital & Clinical Pharmacy 9th edition, Nirali Publications , Pune, 1999	
7	S.J. Carter, Cooper & Guns. Dispensingfor Pharmaceutical Students 12th edition,Pitman Books, 1987	
8	RM Mehta, Drug store and Business Management , Vallabh Prakashan, 3rdedition 2009	
9	M Burande, Principles and Practice of Drug Store Administration Nirali Prakashan, 10thedition 2008	
Course Outcomes (students will be able to…..)		
	Forensic Pharmacy:	
1	To understand history of Pharmacy and relate health care	
2	Able to understand pharmacy acts and related to pharmacy sector	
3	Able to understand patents and laws related to IPR	
4	To comprehend patent filling and submission process	
5	Able to select some act for particular reasons	
	Drug Store Management: Upon completion of the course, it is expected that students will be able to	
1	Practice pharmaceutical care and the contemporary role of the pharmacist in the hospital setting	
2	Deal with problems and control incompatibilities during dispensing or administration to the patient in hospital setting	
3	Implement the Best practices of Pharmaceutical Trade	
4	Bring qualitative advancement in services of the community pharmacy and establish the concept of retail management in an atmosphere of specialization	

	Course Code: PHP1403	**Course Title: Pharmaceutical Chemistry Laboratory**	**Credits = 2**		
			L	**T**	**P**
	Semester: V	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Organic chemistry practicals I and II				
List of Courses where this course will be prerequisite					
	All Pharmaceutical Chemistry and Medicinal Chemistry Courses				
Description of relevance of this course in the B. Pharm. Program					
To train the students in standard laboratory practices with respect to safety, understand qualitative analysis of organic molecules					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
	Functional group transformation: Minimum one exercise to be given for each of the following types of transformations, if possible leading to synthesis of drugs or drug intermediates				
1	Techniques in organic synthesis		8		
2	Esterification		4		
3	Hydrolysis		4		
4	Amide formation (acetylation, benzoylation),		4		
5	Diazotization and coupling		4		
6	Bromination		4		
7	Nitration and Sulfonation in aromatic rings		8		
8	Simple oxidation and reduction reactions		8		
9	Synthesis of Heterocycles (e.g. Hydantoin, Benzimidazole)		8		
10	Aliphatic substitution reactions		4		
11	Clasien / aldol condensation		4		
	List of Text Books/ Reference Books				
1	Arthur, Vogel. Textbook of practical organic chemistry, 5thedition, publishers Longman group Ltd, 1989				

2	J. Leonard, trvor P. Toube, B. Lygo, G Advanced Practical Organic Chemistry. Proctor, 2nd edition, Stanley Thornes. 1990	
3	Keese, R, Martin P. B, and Trevor P. Toube. Practical organic synthesis: a student's guide. John Wiley &Sons, 2006.	
	Course Outcomes (students will be able to…..)	
1	Work safely in the organic chemistry laboratory	
2	Implement techniques for synthetic reactions	
3	Design and carry out experiments for simple organic transformations	
4	Understand reaction mechanisms and their practical implications	

	Course Code:PHP1114	**Cosmeticology Laboratory**	**Credits = 2**		
			L	**T**	**P**
	Semester: V	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Pharmaceutics Laboratory – I, Pharmaceutics Laboratory – II				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the B. Pharmacy					
To train the students with respect to practical aspects of cosmetics product development and quality control thereof					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	Representative examples of skin care cosmetics(Preparation, packaging and evaluation)	12
2	Representative examples of dental care products (Preparation, packaging and evaluation)	12
3	Representative examples of nail care cosmetics(Preparation, packaging and evaluation)	8
4	Representative examples of eye care cosmetics(Preparation, packaging and evaluation)	8
5	Representative examples of hair care cosmetics(Preparation, packaging and evaluation)	8
6	Representative examples of herbal cosmetics (Preparation, packaging and evaluation)	8
7	Representative examples of baby care products (Preparation, packaging and evaluation)	4
Course Outcomes (students will be able to…..)		
1	Formulate and evaluate different cosmetic products	
2	Understand aesthetic packaging of cosmetics	

	Course Code: BSP1203	**Course Title: Microbiology & BiotechnologyLaboratory**	**Credits = 2**		
			L	**T**	**P**
	Semester: V	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Microbiology, Molecular Biology & Biotechnology				
List of Courses where this course will be prerequisite					
	Some topics in Pharmaceutical biotechnology				
Description of relevance of this course in the B. Tech./B.Pharm. Program					
To familiarize students with diverse techniques that form the basis of modern research in microbiology and biotechnology.					

Sr. No.	**Course contents (Topics and subtopics)**	**Reqd. hours**
1	Sterilization and preparation of media	4
2	Isolation of microbes and Preservation of slant and stab cultures	4
3	Air, water microbiology (sterile room)	4
4	Microbial limit test	4
5	Sterility test	4

6	Antibiotic sensitivity	4
7	Demonstration and identification experiments: permanent slides demonstrating various staining techniques like monochrome staining, gram staining, cell wall staining, capsule staining etc	4
8	Isolation of nucleic acids and quantitation	4
9	Enzyme immobilization and estimation	4
10	Studying enzyme kinetics	4
11	Fermentation of biomolecules	8
12	Isolation and purification of biomolecules from crude source/fermentation broth	8
13	Demonstration: Advanced molecular biology techniques like electrophoresis, RT-PCR etc	4
List of Text Books/Reference Books		
1	Pelczar, Michael J., E. C. N. Chan, and Noel R. Krieg. Microbiology. 5th edition,Tata Mc-Graw Hill, 1993	
2	McNeil, Brian, and Linda M. Harvey. Practical fermentation technology. Chichester: Wiley, 2008.	
3	Frobisher, Fundamentals of Microbiology, 10th edition, 2014	
4	Pharmacopoeias: IP,BP,USP,EP	
Course Outcomes (students will be able to)		
1	Knowledge and hands on skills to obtain and preserve microbes as pure cultures	
2	Isolation and quantification of nucleic acids	
3	Perform techniques to immobilise enzymes for further applications	
4	Study kinetics of diverse enzymes for their application in research	
5	Perform microbial fermentation and revover and purify bioproducts	

THIRD YEAR B.PHARM SEMESTER VI

	Course Code: PHT1409	**Course Title:** Pharmaceutical and Medicinal Chemistry –III	**Credits = 3**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Pharmaceutical and Medicinal Chemistry –II				
List of Courses where this course will be prerequisite					
	Pharmaceutical and Medicinal Chemistry –IV, Pharmaceutical and Medicinal Chemistry –V				

Description of relevance of this course in the B. Pharm. Program

To train the students with respect to basics of Central Nervous System drugs, Cholinergic and Adrenergic drugs, Analgesics, Non-Steroidal Anti-inflammatory Drugs

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
	Studyofthefollowingclassesofdrugs withrespecttotheirclassification,chemical nomenclature, structure including stereochemistry, generic names, chemistry, physicochemical properties,SAR,metabolism,molecularmechanism ofactionandsynthesisandintroductionto rational development, if any.	
1	**Drugs Affecting the Central Nervous System**	
	General introduction to biogenic amines and other biomolecules involved in neurotransmission	2
	General anaesthetics: Inhaled general anesthetics and Intravenous general anesthetics.	1
	Sedatives and hypnotics: Benzodiazepines, Non-benzodiazepine, Barbiturates, Misc.	3
	Antiseizure drugs or anticonvulsant agents: Clinical drugs and newer agents	2
	Antidepressants: Selective norepinephrine reuptake inhibitors (SNRIs),Selective 5-HT reuptake inhiitors (SSRIs), Nonselective reuptake inhibitors (NSRIs), Dopamine and norepinephrine reuptake inhibitors (DNRIs), Serotonin antagonist/reuptake inhibitors (SARIs), nonadrenergic specific serotonergic antidepressants (NaSSAs), monoamine oxidase inhibitors (MAOIs), Mood stabilizers.	5
	Antipsychotics: phenothiazes, thioxanthines, benzamide, benzapines, benzisoxazole and benzisothiazoles, misc. agents.	2
	Anxiolytics: Benzodiazapines, Misc agents.	1
	Hallucinogens, Stimulants and related drugs of abuse or analeptics, xanthines, psychedelics: Non classical Hallucinogens- cannabinoids, classical hallucinogens- Indolealkylamines, phenylalkylamines, Central stimulants-amphetamine related agents, cocaine related agents.	2
	Drugs used to treat neuromuscular disorder: Antiparkinsonian and spasmolytic agents.	1
	Drugs affecting serotonergic neurotransmission- drugs for migrane, Irritable Bowel Syndrome, Anitemetic agents.	2
2	**Cholinergic Drugs or Drugs affecting cholinergic neurotransmission:**	
	General aspects of cholinergic receptor and acetylcholine, Acetyl choline mimetics- muscarainic agonist or cholinergic agonists, Anticholine esterases, Acetylcholine antagonists, muscrinic antagonists, Neuromuscular blocking agents.	5
	Drugs for the treatment of Alzheimer's disease	1
3	**Adrenergic Drugs or drugs affecting adrenergic neurotransmission:**	
	General aspects of adrenergic receptors and Non-selective adrenergic agonists- nor- epinephrine and epinephrine.	2
	Selective α1-adrenergic agonists and α2-adrenergic agonists, β1 and β2- adrenergic agonists, Mixed-acting sympathomimetics	3
	Non-selective and Selective α-adrenergic antagonists, β-adrenergic antagonists, Mixed α/β-adrenergic antagonists: Ergot alkaloids	4
4	**Drug Receptor Interactions Introduction:**	
	Understand concept of Drug - Receptor interactions; Affinity of drug for receptor- role of chemical bonding and conformation	1
	Understand concept of Stereochemistry and Bioisosterism in Drug-Receptor interactions	1
	Classification of different families of receptors and enzymes	2
5	**Analgesics:** Opoid or narcotic analgesics: μ-agonists, other analgesics, mixed	5

	agonist/antagonist analgesics, μ-antagonists, Antidiarrheal agents, Cough suppressants, anti-tussives narcotic and others.	
List of Text Books/ Reference Books		
1	Foye, William O. Foye's principles of medicinal chemistry. Edited by Thomas L. Lemke, and David A. Williams, 6th edition, Lippincott Williams & Wilkins, 2008.	
2	Wilson, Charles Owens, and Ole Gisvold, Textbook Of Medicinal And Pharmaceutical Chemistry, 11th edition, Lippincott Williams & Wilkins, Philadelphia, 2004	
3	Donald J. Abraham, David P. Rotella, Burger's Medicinal Chemistry, Drug Discovery and Development, 7th Edition, 8 Volume Set, John Wiley & Sons-New Jersey,2010	
4	Remington, Joseph Price. Remington: The science and practice of pharmacy. Edited by David B. Troy, and Paul Beringer. Vol. 1. Lippincott Williams & Wilkins, 2006.	
5	Iyer R. P, Degani M. S., Synthesis Of Drugs: A Synthon Approach, 2nd edition, Vol-1, Sevak Publications Pvt. Ltd., 2008	
6	Axel Kleemann and Jürgen Engel, Pharmaceutical Substances: Synthesis, Patents, Applications (N-Z) Kleemann 4th edition, Thieme, 2011	
7	Lednicer, Daniel. The organic chemistry of drug synthesis. Vol. 7. John Wiley & Sons, 2007.	
8	R. B. Silverman & Holladay, The Organic Chemistry of Drug Design And Drug Action. 3rd edition, Elsevier Publication, 2014	
Course Outcomes (students will be able to…..)		
1	Draw and understand structures and write IUPAC names of structures (includes 3D structures) and classify drugs	
2	Explain mechanism of action of drugs at molecular level & understand and apply the concepts of SAR.	
3	Comprehend drug-receptor interactions	
4	Predict the synthetic routes for simple drugs	
	Note: The above course outcomes are related to Central Nervous System drugs, Cholinergic drugs, Adrenergic drugs and Analgesics	

	Course Code:PHT1119	**Course Title: Pharmaceutics IV**	**Credits = 3**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Pharmaceutics-III				
List of Courses where this course will be prerequisite					
	Pharmaceutics-V				
Description of relevance of this course in the B. Pharmacy					
In-depth knowledge of granule, tablet, capsule dosage form. Introduction to stability testing and stabilization					
	Course Contents (Topics and subtopics)		**Reqd. hours**		
1	**Tablets Introduction** • Introduction to tablet dosage form, rationale, advantages and limitations • Preformulation considerations for tablet dosage form • Excipients in tableting		5		
2	**Granulation:** • Rationale, types of granulation, equipments used for granulation, Advances in granulation equipments, Roller compaction, Direct compression • Quality control of granules		5		
3	**Tablets Formulation** • Tablet punching: physics of tablet punching, single punch and rotary tablet press, tablet tooling • Problems in tableting and solutions thereof		5		
4	**Types of tablets:** Effervescent, chewable, buccal and sublingual, dispersible, orodispersible, soluble, lozenges		5		
5	**Quality control of tablets, Large scale manufacture and packaging of tablets**		5		
5	**Tablet coating:** • Introduction to tablet coating: rationale, advantages etc.		5		

	• Preformulation considerations for tablet coating
	• Types of coating
	  o Sugar coating: Advantages, excipients in coating, methods, equipments, advances in coating equipments, problems in coating and solutions thereof
	  o Film coating: Advantages, excipients in coating, methods, equipments, advances in coating equipments, problems in coating and solutions thereof with focus on both aqueous and non-aqueous coating
	• Functional coating: taste masking, enteric coating etc.
	• Quality control of coated tablets
	• Large scale manufacture	

6	**Micro-encapsulation:** • Introduction, advantages and limitations • applications in dosage forms • Preformulation considerations for microencapsulation • Methods of microencapsulation: physical, physicochemical and chemical, phase separation coacervation, mutiorifice centrifugal process, spray drying and congealing, orifice methods, polymerization techniques • Equipments • Formulation of microcapsules into dosage forms • Quality control of microcapsules • Large scale manufacture	5

7	**Capsules Introduction :**
	• Introduction to capsule dosage form: rationale, advantages etc.
	• Preformulation considerations for capsule dosage form
	• Gelatin capsules:
	  o Extraction of gelatin by acid and alkali treatment, advances in gelatin extraction, quality control tests
	  o Introduction of hard and soft gelatin capsules, Advantages and limitations
		5

8	**Hard and soft Gelatin capsules:** • Hard gelatin capsules: formulation considerations, capsule manufacture equipments, quality control tests, packaging, Large scale manufacture • Soft gelatin capsules: formulation considerations, capsule filling equipments, quality control tests, packaging, Large scale manufacture • Advances in capsule dosage form	5
	List of Text Books/ Reference Books	
1	Gilbert S.Banker, C.T. Rhodes, Modern Pharmaceutics, ,4th Edition, Marcel Dekker Inc, 2002	
2	Allen, Loyd V., Jr, Remington-The Science And Practice Of Pharmacy (Vol.1& 2), 22nd edition, Lippincott Williams &Wilkins, 2012	
3	Howard C. Ansel, Nicholas G. Popovich, Lord V. Alien, Pharmaceutical Dosage Form And DrugDelivery Systems, 10th edition, 1995, B.I.Waverly Pvt.Ltd.,New Delhi, 2013	
4	Roop K. Khar, S. P. Vyas, Farhad J. Ahmad, Gaurav K. Jain, The Theory and Practice of Industrial Pharmacy- 4th Edition, CRS press, 2013	
5	Graham C.Cole, Pharmaceutical Production Facilities:Design& Applications, 2st Edition , Ellis Horwood, 1998	
6	Pharmacopoeias: Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia, all editions	
7	ICH Guidelines	
	Course Outcomes (students will be able to…..)	
1	Explain the need for granulation methods, advances in equipment and properties of granules.	
2	Detail the formulation and manufacture of tablets, related unit operations, problems in tableting, quality control and explain various types of tablets.	
3	Explain hard gelatin and soft gelatin capsules including manufacture, filling, quality control and packaging.	
4	Describe different types of coating, methods, equipments and materials for coating, quality control of coated tablets and problems in coating.	
5	Explain various methods of microencapsulation, evaluation of microcapsules and describe their conversion into dosage form.	

	Course Code: PHT 1211	**Course Title: Pharmacology- III**	**Credits = 3**

			L	T	P
	Semester: VI	**Total contact hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses		
	Pharmacology- II	

List of Courses where this course will be prerequisite		
	Pharmacology- IV	

Description of relevance of this course in the B.Pharm. Program

To teach the students about the drugs acting on the CNS and ANS

Sr. No.	Course contents (Topics and subtopics)	Reqd. hours
1	**Drugs acting on CNS:** Alcohol: Ethanol, Methanol, Disulfiram	5
2	**General Anaesthetics:** History, classification, stages of anaesthesia, pre-anaestheticmedicine,Basalanaesthetic agents,Neuroleptanalgesia,	6
3	Latest agents: Sedative, hypnotics, anxiolytics. Antidepressants	6
4	Anticonvulsants and Antiparkinsonism.	5
5	CNS stimulant, Opiod analgesics/NSAIDS; Centrally acting muscle relaxants	7
6	Local anaesthetics	3
7	**Drugs acting on ANS:** Cholinergic,anticholinergic agents	5
8	Adrenergic, adrenergic blocking agents	5
9	Drugs acting on Neuro Muscular Junction; Ganglion Blockers/stimulators	3
	List of Text Books/Reference Books	
1	Rang and Dale, Textbook of Pharmacology,8th edition, Elsevier, 2015	
2	Tripathi K D., Essentials of Medical Pharmacology, 7th edition, Published by Jaypee brothers, 2013	
3	Lippincott's Illustrated Reviews, Pharmacology 6th edition, wolterskluwer, 2015	
4	R.S.Satoskar, S.D.Bhandarkar, Pharmacology and Pharmacotherapeutics 24th Edition, 2015	
5	F.S.K.Barar, Essentials of Pharmacotherapeutics 1st edition, S.Chand and Company Ltd, 2004	
	Course Outcomes (students will be able to)	
1	Understand the effect of alcohol, sedative, hypnotics, anxiolytics, anticonvulsants, antidepressants, antiparkinsonism, CNS stimulants, opoid analgesics, NSAIDS, centrally acting muscle relaxants on CNS.	
2	Understand the pharmacology of general anesthetics and local anesthetics.	
3	Understand the effect of cholinergic, anticholinergic, adrenergic, adrenergic blocking agents on ANS.	
4	Understand the effect of ganglion blockers/stimulators on NMJ.	

	Course Code : PHT 1504	**Course Title: Pharmacognosy I**	**Credits = 3**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses		
	HSC Biology and Chemistry	

List of Courses where this course will be prerequisite		
	All pharmacognosy, phytochemistry and medicinal natural product courses	

Description of relevance of this course in B-Pharm Program

To train the students with the basics of pharmacognosy and phytochemistry

Sr. No.	Course contents (Topics and subtopics)	Reqd Hours
1	General Pharmacognosy: Definition, history, indigenous systems of medicine. Source of drugs, organized drugs and unorganized drugs, nutraceuticals, functional food, food supplements, etc.	3
2	Scope of Pharmacognosy: Origin, geographical source & habitat, history, cultivation, pest control, preparation for market, identification, chemical constituents, uses, allied drugs, substitutes, adulterants	3
3	Plant growth regulators/ Hormones, Applications of plant tissue culture in pharmacognosy, Edible vaccines	3
4	Cell cultures as source of drugs and propagation	2

5	Classification of crude drugs: Alphabetical, biological, morphological, pharmacological, chemical, chemo-taxonomical, etc.	5
6	Standardization of drugs of natural origin: Organoleptic, microscopic, macroscopic, biological, chemical, spectral, and physical methods. Application of chromatographic techniques in evaluation of herbal drugs. Evaluation of crude drugs, extracts and phytoconstituents, etc.	5
7	Plant description, morphology, cell differentiation and ergastic cell contents: Study of plant parts, cell and tissue, underground or subterranean drugs, roots, rhizomes, corms, bulb, tubers, stolen, runners, and suckers; Leaves: Simple and compound, stomata, stomata number, stomatal index, palisade - ratio, hydathodes and water pores, epidermal trichomes, calcium oxalate crystals, vein-islet number, vein termination number; Inflorescence and flowers; Fruits; Seeds; Barks, and wood.	3
8	Unorganised drugs: Dried latex, dried juices, dried extracts, gums and mucilages, resins, etc.	2
9	Phytochemistry: General properties, structures, classification, methods of extraction, etc. of Carbohydrates, proteins, enzymes, lipids, volatile oils, glycosides (anthraquinone, cyanogenic, steroidal, etc.	5
10	General properties, structures, classification, methods of extraction, etc. Of triterpenoidal, coumarin, flavonoid, glucosinolate, etc.) tannins, alkaloids, etc.	5
11	Biosynthesis: Building blocks, reactions involved in the biosynthesis, biosynthesis of building blocks. (acetate, isopenntenyl pyrophosphate, phenyl propane, etc.,), Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.	5
12	Extraction: Methods employed for the extraction of natural products mentioned under phytochemistry. Types of extracts. Methods used for separation of phytoconstituents	3
13	Minerals- Kiselghur, Chalk, Talc, and Bentonite	1
List of Text Books/ Reference Books		
1.	Dewick, Paul M. Medicinal natural products: a biosynthetic approach. 2nd edition, John Wiley &Sons, 2002	
2.	Bruneton J, Pharmacognosy & Phytochemistry Medicinal Plants,2nd edition, Lavoisier Publishing Inc. 1999	
3.	Harborne J.B. Phytochemical Methods- A Guide to modern techniques of Plant analysis, 3rd edition,Springer, 1998	
4.	Ikan R., Natural Products- A Laboratory Guide, 2nd edition, Academic Press, 1994	
5.	Tyler V.E., Pharmacognosy, 8th edition, Lea & Febiger, 1981	
6.	Trease & Evans, Textbook of Pharmacognosy, 16th edition, Harcourt Publishers, 2009	
7.	Wallis, Thomas Edward, Textbook of Pharmacognosy, 5th edition, J. & A. Churchill Ltd,1967	
8.	Wagner, Hildebert, and Sabine Bladt. Plant drug analysis: a thin layer chromatography atlas. Springer Science & Business Media, 1996.	
9.	Wealth of India (11 volumes), Publications and Information Directorate, CSIR, 1992	
10.	Jackson B.P., DW.Snowdon, Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices, CBS Publishers, 1990	
11.	The Merck Index, Merck Research Laboratories, 13th edition, Merck & Co., Inc, 2001	
12.	Indian Pharmacopoeias, 2010, Government of India, Controller of Publications, Delhi	
13.	Ayurvedic Pharmacopoeia of India, AYUSH, CCRAS	
14.	Quality Standards of Indian Medicinal Plants, all volumes, ICMR	
15.	Indian Medicinal Plants, Kiritikar and Basu	
Course Outcome (students will be able to...)		
1	Undertake systematic identification of different plant / herbal material.	
2	Describe the requirement of cultivation and collection of herbal drugs.	
3	Describe post harvest treatment for preparation for market.	
4	Evaluate purity and safety of plant material.	
5	Describe comprehensive requirement for setting up of extraction plant	

	CourseCode:HUT1106	**Course Title: Environmental Science and Technology**	**Credits= 3**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					

List of Courses where this course will be prerequisite		
Sr. No.	**Course Contents(Topics and subtopics)**	**Reqd. hours**
1	**Multi disciplinary Nature of Environmental Studies:** • Scope and Importance • Need for Public Awareness • Depleting Nature of Environmental resources such as Soil, Water, Minerals, and Forests. • Global Environmental Crisis related to Population, Water, Sanitation and Land. • Ecosystem: Concept, Classification, Structure of Ecosystem, overview of Foodchain, Foodweb and Ecological Pyramid	4
2	**Sustainable Development** • Concept of sustainable development • Social, Economical and Environmental aspect of sustainable development. • ControlMeasures:3R (Reuse, Recovery, Recycle),Appropriate Technology, Environmental education, Resource utilization as per the carrying capacity**.**	4
3	**Environmental Pollution:** • Air Pollution: Sources, Effects of air pollution with respect to Global Warming, Ozone layer Depletion, Acid Rain, Photo chemical smog, Two Control Measures-Bag house Filter, Venturiscrubber. Case Study • Water Pollution: Sources and Treatment, Concept of was tewaters- Domestic &Industrial and treatment. Case Study • Land Pollution: Solid waste, Solid waste Management by Land filling, Composting. • Noise Pollution; Sources and Effects • E-Pollution:Sources and Effects.	7
4	**Environmental Legislation:** • Overview • Ministryof Environment and Forests (MoE&F).Organizational structure of MoE &F. • Functionsand powers of Central Control Pollution Board. • Functionsand powers of State Control Pollution Board. • Environmental Clearance, Consent and Authorization Mechanism. • Environmental Protection Act • Any two case studies pertaining to Environmental Legislation.	5

5	**Renewable sources of Energy:** • Limitationsof conventional sources of Energy. • Various renewable energy sources. • Solar Energy: Principle, Working of Flatplate collector &Photovoltaic cell. • Wind Energy: Principle, Wind Turbines.	5
6	**Environment and Technology** • Role of Technology in Environment and health • Concept of Green Buildings, Indoor air pollution • Carbon Credit: Introduction, General concept. • Disaster Management: Two Events: Tsunami, Earthquakes, Techniques of Disaster Management • Case Study	5
List of Text Books/ Reference Books		
1	Textbook of Environmental studies by Erach Bharucha, University Press.	
2	Environmental Studies by R. Rajagopalan, Oxford University Press.	
3	Essentials of Environmental Studies by Kurian Joseph &Nagendran, Pearson Education	
4	Renewable Energy by Godfrey Boyle, Oxford Publications.	
5	Perspective Of Environmental Studies, by Kaushik and Kaushik, New Age International	
6	Environmental Studies by. Anandita Basak, Pearson Education	
7	Textbook of Environmental Studies by Dave and Katewa, Cengage Learning	
8	Environmental Studies by Benny Joseph, Tata McGraw Hill	

	Course Code:PHP1115	**Pharmaceutics (including Biopharmaceutics) Laboratory - III**	**Credits = 2**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Pharmaceutics-I, Pharmaceutics-II , Pharmaceutics-III, , Pharmaceutics Laboratory – I, Pharmaceutics Laboratory – II				
List of Courses where this course will be prerequisite					
	Pharmaceutics-V, Pharmaceutics-VI, Pharmaceutics Laboratory – IV, Pharmaceutics Laboratory – V				
Description of relevance of this course in the B. Pharmacy					
To train the students with respect to practical aspects of pharmaceutical solid unit dosage form development and quality control thereof. Introduction to practical applications and calculations related to biopharmaceutics					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
1	Representative examples of granules ready for compression (Preparation, packaging and evaluation)		8		
2	Representative examples of tablets (Preparation, packaging and evaluation)		24		
3	Representative examples of tablet coating (Preparation, packaging and evaluation)		8		
4	Representative examples of capsules (Preparation, packaging and evaluation)		8		
5	Representative examples of microencapsulation (Preparation, packaging and evaluation)		8		
6	Dissolution testing: • Conventional marketed formulations representing- soluble drug, poorly soluble drug (selection of medium)		4		
Course Outcomes (students will be able to…..)					
1	Prepare and evaluate granules ready for compression				
2	Prepare, evaluate and label pharmacopoeial and non pharmacopoeial solid oral dosage forms				
3	Perform microencapsulation				
3	Perform dissolution testing for oral dosage forms				

	Course Code: PHP1205	Course Title: – Pharmacology Laboratory-I	Credits = 2		
			L	T	P
	Semester: VI	Total contact hours: 60	0	0	4

List of Prerequisite Courses

	Anatomy, Physiology & Pathophysiology-Laboratory

List of Courses where this course will be prerequisite

	Pharmacology Laboratory-II

Description of relevance of this course in the B.Pharm. Program

To teach students the practical aspects of pharmacology: ex vivo and in vivo experiments

Sr. No.	Course contents (Topics and subtopics)	Reqd. hours
1	Ideal animal house maintainance, animal care and handling and acute and subacute toxicity. In accordance with CPCSEA. OECD guidelines and Schedule Y	2*4
2	Dose response curve on isolated tissue preparation	4*4
3	Nature of agonist/ antagonist activity	2*4
4	PA_2 value calculation	2*4
5	Demonstration of routes of administration	2*4
6	Demonstration of experiments on rabbit eye	1*4
7	Effect of drugs on normal and hypodynamic heart (Demonstration)	1*4
8	Effect of drugs on perfused isolated heart (Demonstration)	1*4

List of Text Books/Reference Books

1	Kulkarni, Shrinivas Krishnarao. Hand book of experimental pharmacology. 3rd edition, Vallabh prakashan, 1999.	
2	R.K.Goyal, Practicals in Pharmacology, 6th,edition, B.S.Shah Prakashan, Ahmedabad, 2006- 2007	
3	U.K.Seth, N.K.Dadkar, Usha G.Kamat, Selected Topics in Experimental Pharmacology, 1st edition, Kothari Book Depot Mumbai, 1972	
4	Ghosh M.N, Fundamentals of Experimental Pharmacology, 3rd edition, Hilton and Co, Kolkata, 2005	

Course Outcomes (students will be able to)

1	Understand ideal animal house maintainance, animal care, handling and acute and subacute toxicity in accordance with CPSCEA, OECD guidelines and schedule Y.	
2	Perform dose response curve on isolated tissue preparation; interpret the nature of agonist / antagonist activity and calculate PA_2 value.	
3	Identify different routes of administration of drugs in mice/rats and understand the effect of autonomic drugs on rabbit's eye.	
4	Understand the effect of drugs on normal and hypodynamic heart and perfused isolated heart using suitable experiments.	

	Course Code : PHP1504	Course Title: Pharmacognosy Laboratory I	Credits = 2		
			L	T	P
	Semester: VI	Total contact hours: 60	0	0	4

List of Prerequisite Courses

	HSC Biology and Chemistry

List of Courses where this course will be prerequisite

	All pharmacognosy, phytochemistry and medicinal natural product courses

Description of relevance of this course in B-Pharm Program

To train the students with the basics of pharmacognosy and phytochemistry

Sr.	Course contents (Topics and subtopics)	Reqd.hours

No.		
1	Study of simple and compound microscope, magnification, micrometry, and microscopical drawing using camera lucida, Projection microscope. Use and care of microscope, etc.	4
2	Studies on morphological features of leaves, roots and rhizomes, stem, flowers, fruits, seeds, barks, woods, etc	4
3	Studies of plant tissues : palisade, epidermis, cork, parenchyma, collenchyma, sclerenchyma, vascular tissues, secretary organs, spores, etc	4
4	Studies of stomata (diacytic, paracytic, animocytic, anisocytic, dumb-bell shaped stomata, etc.)	4
5	Studies of covering and glandular trichomes (minimum of 5 each type).	4
6	Studies of calcium oxalate crystals (acicular, prism, rosette, sandy, microneedles, crystal sheath, etc.	4
7	Studies on starches (maize, wheat, rice, potato, etc.).	4
8	Determination of stomatal number and stomatal index	4
9	Determination of palisade ratio	4
10	Determination of vein-islet and vein termination number, Quantitative microscopy using lycopodium spores.	4
11	Determination of total ash and acid insoluble ash	4
12	Determination of alcohol and water soluble extractive values	4
13	Development of thin layer chromatography for two drugs (alkaloids, volatile oils, glycoside, etc	4
14	Evaluation of volatile oil/fixed oil by R.I , Determination of swelling factor (isabgol seed or husk)	4
15	Determination of moisture content by (Karlfisher method, LOD, etc.)	4
List of Text Books/Reference Books		
1.	Dewick, Paul M. Medicinal natural products: a biosynthetic approach. 2nd edition, John Wiley & Sons, 2002	
2.	Bruneton J, Pharmacognosy & Phytochemistry Medicinal Plants,2nd edition, Lavoisier Publishing Inc. 1999	
3.	Harborne J.B. Phytochemical Methods- A Guide to modern techniques of Plant analysis, 3rd edition,Springer, 1998	
4.	Ikan R., Natural Products- A Laboratory Guide, 2nd edition, Academic Press, 1994	
5.	Tyler V.E., Pharmacognosy, 8th edition, Lea & Febiger, 1981	
6.	Trease & Evans, Textbook of Pharmacognosy, 16th edition, Harcourt Publishers, 2009	
7.	Wallis, Thomas Edward, Textbook of Pharmacognosy, 5th edition, J. & A. Churchill Ltd,1967	
8.	Wagner, Hildebert, and Sabine Bladt. Plant drug analysis: a thin layer chromatography atlas. Springer Science & Business Media, 1996.	
9.	Wealth of India (11 volumes), Publications and Information Directorate, CSIR, 1992	
10.	Jackson B.P., DW.Snowdon, Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices, CBS Publishers, 1990	
11.	The Merck Index, Merck Research Laboratories, 13th edition, Merck & Co., Inc, 2001	
12.	Indian Pharmacopoeias, 2010, Government of India, Controller of Publications, Delhi	
13.	Ayurvedic Pharmacopoeia of India, AYUSH, CCRAS	
14.	Quality Standards of Indian Medicinal Plants, all volumes, ICMR	
15.	Indian Medicinal Plants, Kiritikar and Basu	
Course Outcome (students will be able to...)		
1	Understand microscopical examination and evaluation of herbal drugs.	
2	Identify herbal drugs on morphological basis.	
3	Undertake physical and chemical tests for herbal raw material and other natural products.	
4	Analyse isolated constituents by thin layer chromatography.	
5	Evaluate of volatile oil and fixed oil.	

	Course Code: PHP1702	**Course Title: Seminar**	**Credits = 2**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	All courses related to the given seminar topic				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the B. Pharm. Program					
The course familiarizes the students with literature collection and analysis, and deriving a solution for a problem related to pharmacy.					

Sr. No.	Course contents (Topics and subtopics)	Reqd. hours
1	Carry out appropriate, current literature survey	
2	Compile data in a scientific and logical sequence which reflects an understanding of the topic.	
3	Present the topic in a written format along with data analysis.	
4	Organise a presentation, and present the data as effective audio-visual presentation and answer relevant questions to defend the same.	
5	Write references in correct format.	

Course Outcomes (students will be able to)	
1	Retrieve literature information on the topic
2	Effectively compile the literature as a report that reflects on understanding the topic
3	Present the solution and defend the questions

FINAL YEAR B.PHARM SEMESTER VII

	Course Code: PHT1410	**Course Title: Pharmaceutical and Medicinal Chemistry –IV**	**Credits = 3**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Pharmaceutical and Medicinal Chemistry –III				
List of Courses where this course will be prerequisite					
	Pharmaceutical and Medicinal Chemistry –V				

Description of relevance of this course in the B. Pharm. Program

To train the students with respect to basics of Cardiovascular Drugs and antidiabetic drugs, eiconosides, and pharmaceutical biotechnology

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
	Studyofthefollowingclassesofdrugs withrespecttotheirclassification,chemical nomenclature, structure including stereochemistry, generic names, chemistry, physicochemical properties,SAR,metabolism,molecularmechanism ofactionandsynthesis of 4-5 compounds from each therapeutic area andintroductionto rational development, if any.	
1	**Cardiovascular Drugs:** **a) Cardiac agents:** Cardiac glycosides and non-glycosides, Anti-anginalagents, Nitrates and nitrites, nitric oxide donors, Calciumchannel blockers, Antiarrhythmic drugs: Class I to IV. **b) Diuretics:** Osmotic diuretics, Carbonic anhydrase inhibitors, Thiazide and thiazide like diuretics, Loop diuretics, Aldosterone antagonists, Potassiumsparing diuretics **c) Antihypertensive agents:** ACE inhibitors, Ca channels blockers, Adrenergicblockers, Vasodilators, Miscelleneous. d) Antihyperlipidemic agents and cholesterol reducing agents; Drugs affecting blood clotting - Anticoagulants: Heparin andoral, Direct thrombin inhibitors, Thrombolytics, antiplatelet drugs and Antifibrinolytic agents.	5 5 6 6
2	**Peptide and protein drugs:** Therapeutic drugs, methods of manufacture	5
3	**Anti-diabeticagents:** a) Insulin: Details of structure, properties b) Sulfonylureas, PPAR-agonists and Miscelleneous.	3 5
4	Introduction to eiconosides	2
5	Introduction to pharmaceutical biotechnology a) Antigens, antibiotics, diagnostic kits b) Vaccines, monoclonal antibodies in therapeutics	3 3
6	Introduction to antisense agents	2

List of Text Books/ Reference Books

1	Foye, William O. Foye's principles of medicinal chemistry. Edited by Thomas L. Lemke, and David A. Williams, 6th edition, Lippincott Williams & Wilkins, 2008.
2	Wilson, Charles Owens, and Ole Gisvold, Textbook Of Medicinal And Pharmaceutical Chemistry, 11th edition, Lippincott Williams & Wilkins, Philadelphia, 2004
3	Donald J. Abraham, David P. Rotella, Burger's Medicinal Chemistry, Drug Discovery and Development, 7th Edition, 8 Volume Set, John Wiley & Sons-New Jersey,2010
4	Remington, Joseph Price. Remington: The science and practice of pharmacy. Edited by David B. Troy, and Paul Beringer. Vol. 1. Lippincott Williams & Wilkins, 2006.
5	Iyer R. P, Degani M. S., Synthesis Of Drugs: A Synthon Approach, 2nd edition, Vol-1, Sevak Publications Pvt. Ltd., 2008
6	Axel Kleemann and Jürgen Engel, Pharmaceutical Substances: Synthesis, Patents, Applications (N-Z) Kleemann 4thedition, Thieme, 2011
7	Lednicer, Daniel. The organic chemistry of drug synthesis. Vol. 7. John Wiley & Sons, 2007.

8	R. B. Silverman & Holladay, The Organic Chemistry of Drug Design And Drug Action. 3rd edition, Elsevier Publication, 2014	
Course Outcomes (students will be able to…..)		
1	Draw and understand structures and write IUPAC names of structures (includes 3D structures)	
2	Explain mechanism of action of drugs at molecular level.	
3	Understand and apply the concepts of SAR.	
4	Predict the synthetic route for simple drugs	
5	Grasp basic concepts of biotechnology based drugs	
	Note: The course outcomes 1- 4 are related to Cardiovascular Drugs and antidiabetic drugs	

	Course Code:PHT1120	**Course Title: Pharmaceutics V**	**Credits = 3**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Pharmaceutics-I				
List of Courses where this course will be prerequisite					
	Pharmaceutics-VI				
Description of relevance of this course in the B. Pharmacy					
In-depth knowledge of sterile pharmaceuticals, ophthalmic products, blood and blood substituents, sutures and ligatures.					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	**Parenteral formulations** • Introduction to sterile dosage forms, routes of parenteral administration • Preformulation considerations for sterile dosage forms : small volume parenterals, large volume parenterals	5
2	**Unit operations and facility requirements for Parenterals** • Methods of sterilization • Freeze drying: Introduction, principle, equipment, sterilization • Water for Injection: Monograph IP, methods of preparation, quality control tests, storage • Facility design for parenteral manufacture with focus on air systems HEPA filters, environmental classes for manufacture of parenterals	5
3	**Containers and Closures for Parenteral Formulations:** • Glass and plastic as a container material; ampoules, vials, bottles, rubber closures manufacturing, quality control.	5
4	**Small volume parenterals:** Advantages, discuss various dosage forms like solutions, suspensions, emulsions, dry powders w.r.t. excipients, methods, equipments, advances, problems and solutions thereof and quality control	5
5	**Scaleup considerations** • **Large scale manufacturing of small volume parenterals,** sterilization methods, Introduction to large volume parenterals and comparison with small volume parenterals	5
6	**Ophthalmics:** • Introduction to Ophthalmic dosage form • Anatomy of eye, factors affecting ophthalmic drug absorption • Preformulation considerations for ophthalmic dosage forms • Dosage forms: discuss various dosage forms like solutions suspensions, ointments, gels, films, inserts, lenses etc. w.r.t advantages and limitations, excipients, methods, equipments, advances, problems and solutions thereof • Quality control of ophthalmics • Sterilization	5
7	**Ophthalmics:** • Large scale manufacture and packaging **Contact lens solutions:** Rationale, , excipients, methods, equipments, advances, problems and solutions thereof, Quality control tests	5

8	**Blood products, plasma substitutes and Glandular products** **Blood products and Glandular products** • Introduction, advantages and limitations • Collections and storage techniques for whole blood • Methods of blood and plasma fractionation into individual components • Packaging • Quality control tests • Insulin and insulin formulations P**lasma substitutes** • Introduction, advantages and limitations • Methods of preparation • Packaging • Quality control tests	5
9	**Sutures and ligatures** • Introduction, advantages and limitations • Difference between sutures and ligatures • Types of material used for sutures and ligatures e.g. absorbable and non-absorbable • Methods of preparation and equipments used • Quality control tests • Sterilization • Packaging • Advances	5
	List of Text Books/ Reference Books	
1	Gilbert S.Banker, C.T. Rhodes, Modern Pharmaceutics, ,4th Edition, Marcel Dekker Inc, 2002	
2	Allen, Loyd V., Jr, Remington-The Science And Practice Of Pharmacy (Vol.1& 2), 22nd edition, Lippincott Williams &Wilkins, 2012	
3	Howard C. Ansel, Nicholas G. Popovich, Lord V. Alien, Pharmaceutical Dosage Form And Drug Delivery Systems, 10th edition, 1995, B.I.WaverlyPvt.Ltd.,New Delhi, 2013	
4	Roop K. Khar, S. P. Vyas, Farhad J. Ahmad, Gaurav K. Jain, The Theory and Practice of Industrial Pharmacy- 4th edition, CRS press, 2013	
5	Graham C.Cole, Pharmaceutical Production Facilities:Design& Applications, 2nd edition , Ellis Horwood, 1998	
6	Pharmacopoeias: Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia, all editions	
	Course Outcomes (students will be able to…..)	
1	Describe routes of parenteral administration, formulation and processing considerations in development of various types of small volume parenterals including selection of containers and closures.	
2	Describe Anatomy/Physiology of eye and explain formulation considerations, evaluation and packaging of different types of ophthalmic products including contact lens product, describe various considerations in the design of facility of manufacture of parenteral products.	
3	List different blood products methods to obtain the same, their quality control and discuss plasma substitutes, sutures, ligatures and its quality control thereof.	

	Course Code: PHT 1212	**Course Title: Pharmacology- IV**	**Credits = 3**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 45**	**2**	**1**	**0**
	List of Prerequisite Courses				
	Pharmacology III				
	List of Courses where this course will be prerequisite				
	Clinical Pharmacy and Drug Interactions				
	Description of relevance of this course in the B.Pharm. Program				
To teach the students about the drugs acting on CVS and other important systems of the body					

Sr. No.	Course contents (Topics and subtopics)	Reqd. hours

1	Cardiovascular System: Drugs used in the treatment of Hypertension, Congestive cardiac failure	10
2	Arrhythmia, Hyperlipidemia, Angina Pectoris	5
3	Diuretics	4
4	Pharmacology of bronchial asthma and cough	6
5	Immunomodulators:immunostimulants/suppressants; Immunopharmacology: Histamines and antihistaminics	6
6	5-HT and antagonists, kinins, eicosanoids, cytokines, PAF	4
7	Principleoftoxicology:Heavymetalpoisoning,Pesticides,Poisoning,opium poisoning	5
8	Use of radioisotopes in medicine	4
9	Drugs acting on Nitric Oxide	1

List of Text Books/Reference Books		
1	Rang and Dale, Textbook of Pharmacology,8th edition, Elsevier, 2015	
2	Tripathi K D., Essentials of Medical Pharmacology, 7th edition, Published by Jaypee brothers, 2013	
3	Lippincott's Illustrated Reviews, Pharmacology 6th edition, Wolters Kluwer, 2015	
4	Goodman and Gilman, The Pharmacological Basis of Therapeutics, 12th edition, McGraw –Hill Medical Publishing, 2014	

Course Outcomes (students will be able to)		
1	Understand effect of drugs on CVS and drugs acting on Nitric oxide.	
2	Understand the pharmacology of diuretics, bronchial asthma & cough, 5-HT and antagonists, kinins, eicosanoids, cytokines, PAF and immunomodulators.	
3	Understand principles of toxicity and use of radioisotope in medicine.	

	Course Code : PHT 1505	**Course Title: Pharmacognosy II**	**Credits = 3**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses		
	HSC Biology and Chemistry	

List of Courses where this course will be prerequisite		
	All pharmacognosy, phytochemistry and medicinal natural product courses	

Description of relevance of this course in B-Pharm Program

To train the students with the basics of pharmacognosy and phytochemistry

Sr. No.	**Course contents (Topics and subtopics)**	**Reqd.hours**
1	**Carbohydrates** – Agar, Alginic acid, Acacia, Aloe vera gel, Bael, Chitin, Dextrans, Guar gum, Honey, Inulin, Irish moss, Ispaghula, Pectins, Starches, TKP, Tragacanth. Biosynthesis of carbohydrates in brief	6
2	**Acids** - Citrus, Tamarind pulp, Garcinia, Amla	2
3	**Fatty acids and their esters** - Almond oil, Arachis, Castor, Chaulmoogra oil, Coconut oil, Cotton seed oil, Croton, Linseed, Jajoba, Olive oil, Mustard oil, Neem, Sesame, Wheatgerm oil, Fish liver oil, Cocoa butter, Kokum butter, Woolfat, Beeswax, Carnauba wax, lecithin, Spermaceti. Biosynthesis of fatty acids and triglycerides.	6
4	**Protein sand enzymes** - Protein hydrolysate, Gelatin,; Pepsin, Renin, Trypsin, Chymotrypsin, Thrombin, Papain, Ficin, Bromelain, Pancreatin, Hyaluronidase	5
5	**Peptide toxins** : Abrin, Botulinum toxin, Ricin, Bee venom, Snake venom, Scorpion venom	2
6	**Alkaloids:** Derived from Ornithine: Belladonna, Coca, Datura, Hyoscyamus, Stramonium Derived from Lysine :Black pepper, Lobelia Derived from Nicotinic acid: Areca, Tobacco Derived from histidine : Pilocarpus	5
	Alkaloids: Derived from Phenylalanine: Ephedra Derived from tyrosine and tyramine : Colchicum, Opium, Ipecac	5
	Alkaloids: Derived from tryptophan: Cathatharanthus, Cinchona, Ergot, Nuxvomica, Rauwolfia Derived from anthranilic acid : Vasaka	5
	Alkaloids: Purine alkaloids : Cocoa , Coffee, Cola, Tea Terpenoid alkaloid : Aconite Steroidal alkaloid : Kurchi, Solanum, etc	3
7	Biosynthesis of important alkaloids	3
8	Study of fibers (animal, vegetable, mineral, & synthetic) : Cotton, Jute, Flax, Viscose, Cellulosics, Silk, Wool, Asbestos, Glasswool, Nylon, Terylene, Polythene, etc	3

List of Text Books/ Reference Books		
1.	Dewick, Paul M. Medicinal natural products: a biosynthetic approach. 2nd edition, John Wiley & Sons, 2002	
2.	Bruneton J, Pharmacognosy & Phytochemistry Medicinal Plants,2nd edition, Lavoisier Publishing Inc. 1999	
3.	Harborne J.B. Phytochemical Methods- A Guide to modern techniques of Plant analysis, 3rd edition,Springer, 1998	
4.	Ikan R., Natural Products- A Laboratory Guide, 2nd edition, Academic Press, 1994	
5.	Tyler V.E., Pharmacognosy, 8th edition, Lea & Febiger, 1981	
6.	Trease & Evans, Textbook of Pharmacognosy, 16th edition, Harcourt Publishers, 2009	
7.	Wallis, Thomas Edward, Textbook of Pharmacognosy, 5th edition, J. & A. Churchill Ltd,1967	
8.	Wagner, Hildebert, and Sabine Bladt. Plant drug analysis: a thin layer chromatography atlas. Springer Science & Business Media, 1996.	
9.	Wealth of India (11 volumes), Publications and Information Directorate, CSIR, 1992	
10.	Jackson B.P., DW.Snowdon, Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices, CBS Publishers, 1990	
11.	The Merck Index, Merck Research Laboratories, 13th edition, Merck & Co., Inc, 2001	
12.	Indian Pharmacopoeias, 2010, Government of India, Controller of Publications, Delhi	
13.	Ayurvedic Pharmacopoeia of India, AYUSH, CCRAS	
14.	Quality Standards of Indian Medicinal Plants, all volumes, ICMR	
15.	Indian Medicinal Plants, Kiritikar and Basu	
Course Outcome (students will be able to...)		
1	Know various constituents presents in plants and their application in pharmaceutical and other field.	
2	Have knowledge about various secondary metabolites of pharmacological importance and their occurrence and separation.	
3	Know the processing involved in preparation and refining of fixed oil and their applications. .	
4	Undertake isolation of phytoconsituents.	
5	Perform analysis of carbohydrates, lipids and alkaloids.	

	Course Code: HUT1202	**Course Title: Pharmaceutical Management**	**Credits = 3**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Communication skills and Psychology				
List of Courses where this course will be prerequisite					
	M.Pharm and Research				
Description of relevance of this course in the B.Pharm. Program					
Important to understand managerial aspects such as planning, marketing, strategy, sales, accounting and technology in the pharmaceutical industry					

Sr. No.	**Course contents (Topics and subtopics)**	**Reqd. hours**
1	a) Fundamentals of Management: Meaning of management, functions of management, importance of management, difference between management and administration; b) Development of management thought :Henry Fayol, F.W.Taylor, Peter Drucker, Max Weber, Mary Parker Follet, G.E. Mayo - concept, functions, advantages and limitations, applicable to all sectors of pharmaceutical business ,	2
2	a) Organizations – Formal and Informal; Types of organizational structures; b) Delegation of Authority and Decentralisation; Advantages and Disadvantages c) Controlling systems and process of control. Control techniques: human resource and technological: both qualitative and quantitative d) Techniques of communication, direction, participation, delegation, decision making, control tools (PERT, CPM), systems, policies, procedures, methods to operate organization e) Introduction to hardware and software: networking concepts, data communication, functional applications of of MIS, application of certain software in management: EXCEL, ERP, SAP, etc	5
3	Leadership –	5

	a) Definition, need and importance, traits of a leader, leadership styles, Types of Leaders and leadership, Role models from Industry b) Trait theory, Behavioural theory, Managerial Grid, Contingency Theory, Situational Theory, Path-Goal Theory c) Transactional Analysis and Gestalt Theory	
4	Motivation – needs, wants and processes. a) Maslow's hierarchy of human needs b) Herzberg's two-factor theory of motivation c) Vroom's theory of Expectancy d) Understanding business forecasting, market demand and sales strategy with conflict resolution, creativity and innovation, delegation and decision making.	3
5	Managerial Economics & Product management - a) Nature and scope of managerial economics; Demand theory and analysis; Determinants of demand – price, income, quality, market, competition, market elasticity b) Theory of Consumer choice: The Cardinal Utility Approach; Indifference Curve Approach; Revealed Preference and the theory of Consumer choice under risk c) Production theory and estimation. The Cost theory and estimation. The short and long run cost functions. Theories of Cost. d) Time Management vis a vis Product Development, Software Development and Implementation, Market surveys, e) Strategic Planning, SWOT analysis, PERT & CPM, Contingency Planning, Innovative research & development (need-based) , IPRS in strategic business planning (patents – national and international)	7
6	Marketing Management – a) Concept, definition, nature of marketing, marketing tasks, and marketing management philosophies b) Marketing Information Systems & Market research c) Pharmaceutical Market – buyer and consumer behaviour d) Marketing Pillars –product and market segmentation, targeting, positioning, advertising and sales promotion, retail management, market measurement and forecasting e) Pricing decisions - Pricing methods & strategies, Branding, packaging and labeling	5
7	Sales forecasting - a) Budgeting, budgetary planning and controls b) Operations management, developing and managing products : old and new c) Production planning & control systems; d) Materials management systems; Inventory schedule, planning and management e) Sales promotion, trade shows, exhibitions, sales meetings, sales training manuals ,	6
8	Supply chain management – a) Scope of supply chain management in pharma sector b) Drivers and obstacles of supply chain c) Identification of vendors, pricing, negotiation d) Management of inventories - Procurement of raw materials and packing materials e) Transportation and despatch planning f) Logistic management in supply chain g) Financial factors significant for supply chain h) Role of information technology in supply chain	7
9	Money management – a) Labour laws b) Taxation - Direct taxes - Income tax, corporate tax ; Indirect taxes -excise duty, sales tax and octroi	5
	List of Text Books/Reference Books	
1	Smith M., Principles of Pharmaceutical Marketing. 3rd edition, CBS Publisher & Distributors, , New Delhi, 2001.	
2	Chandra P., Financial Management:Theory and Practice, 8thedition, McGraw Hill Education (India) Private Limited; 2011.	

3	Ashwathapa K., Human Resource management: Text and cases, 7thedition TMH, 2013	
4	Ashwathapa K.., Production & Operations Management, Himalayan Books, 2011.	
5	Hanfield R.B. and Nichols E. L. Jr., Introduction to Supply Chain Management, Prentice Hall, 1998.	
	Course Outcomes (students will be able to)	
1	To learn the Pharmaceutical business and management strategy	
2	To gain knowledge of marketing research, product management	
3	To learn supply chain management and aspects of law and taxation	
4	Understanding business forecasting, market demand and sales strategy	
5	Dealing with human resource and managing conflict resolution, creativity and innovation, delegation and decision making successfully for better productivity and gain for the organization .	
6	Need to use updated and latest software and technology in order to be able to face competition in the market. Moreover, the student has to be also updated with the latest medical inventions and research developments in order to keep up with pharmaceutical requirements to combat diseases and illnesses, viruses and bacteria.	

	Course Code: PHT 1213	**Course Title: Clinical Pharmacy and Drug Interactions**	**Credits = 3**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses

	Pharmacology IV	

List of Courses where this course will be prerequisite

	Higher education	

Description of relevance of this course in the B.Pharm Program

To teach the students about the clinical pharmacy practices

Sr. No.	Course contents (Topics and subtopics)	Reqd. hours
1	Introduction: History and Scope of Clinical Pharmacy	6
2	Concept of Clinical Pharmacy	7
3	Role of Clinical Pharmacy in Patient care	6
4	Patient Counselling andCommunication Skills	6
5	Adverse drug reactions and introduction to Pharmacovigilance	7
6	Drug Problems in geriatrics and pediatrics	6
7	Pharmacokinetic, Pharmacokinetic drug reactions and Toxicokinetics	7
	List of Text Books/Reference Books	
1	Remington, Joseph Price. Remington: The science and practice of pharmacy. Edited by David B. Troy, and Paul Beringer. Vol. 1. Lippincott Williams & Wilkins, 2006.	
2	Walker, Roger. Clinical pharmacy and therapeutics. Elsevier Health Sciences, 5th edition, Churchill Livingstone, Edinburgh, 2011.	
3	Hansten, Philip D., and John R. Horn. Drug interactions: Clinical significance of drug-drug interactions, 5th edition,1985 Lea And Febiger, Philadelphia, 1989	
4	Dr R.K.Goyal, Dr P.A.Bhatt, Dr M.D.Burande, Elements Of Clinical Pharmacy, B.S.Shah Prakashan, 2nd edition Ahmedabad, 2004-2005	
5	A.V.Yadav, B.V.Yadav, T.I.Shaikh, A Handbook Of Clinical Pharmacy, 2ndedition, Nirali Prakashan, Pune, 2004	
	Course Outcome (students will be able to...)	
1	Understand history, scope and concept of clinical pharmacy.	
2	Understand role of clinical pharmacy in patient care and importance of patient counseling and communication skills.	
3	Understand adverse drug reactions and pharmacovigilance and drug problems in geriatrics and pediatrics.	
4	Understand pharmacokinetic, pharmacokinetic drug reactions and toxicokinetics.	

	Course Code:PHP1116	Pharmaceutics Laboratory IV	Credits = 2		
			L	T	P
	Semester: VII	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
	Pharmaceutics/ Biopharmaceutics Laboratory – III				
List of Courses where this course will be prerequisite					
	Pharmaceutics-VI				
Description of relevance of this course in the B. Pharmacy					
To train the students with respect to practical aspects of parenteral and ophthalmic pharmaceutical formulation development, quality control including BMR					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Representative examples of small volume parenterals (Preparation, sterilization packaging and evaluation, Batch record preparation and exposure to aseptic facility)	24
2	Testing of containers and closures for parenterals	12
3	Monographic testing of water for injection IP	4
4	Large volume parenteral prototype	4
5	Representative examples of ophthalmic formulations (Preparation, packaging and evaluation)	12
6	Representative examples of contact lens solution (Preparation, packaging and evaluation)	4
Course Outcomes (students will be able to…..)		
1	Formulate and evaluate parenteral and ophthalmic products	
2	Understand importance of aseptic area	
3	Evaluate primary package for sterile products	

	Course Code: PHP1206	Course Title: – Pharmacology Laboratory-II	Credits = 2		
			L	T	P
	Semester: VII	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
	Pharmacology Laboratory-I				
List of Courses where this course will be prerequisite					
	Higher education				
Description of relevance of this course in the B.Pharm. Program					
To teach students the practical aspects of pharmacology: ex vivo and in vivo experiments					

Sr. No.	Course contents (Topics and subtopics)	Reqd. hours
1	To record dose response curve of acetylcholine using suitable isolated preparations. (3 types of bioassays)	8*4
2	Demonstration of Analgesic activity of drugs	1*4
3	Demonstration of activity of drugs on the Central Nervous System, muscle relaxant activity, catalepsy, catatonia etc. (Use of CDs and other materials to show experiments)[DEMO]	5*4
4	Brief explanation of regulatory toxicity studies.	1*4
List of Text Books/ Reference Books		
1	Kulkarni, Shrinivas Krishnarao. Hand book of experimental pharmacology. 3rd edition, Vallabh prakashan, 1999.	
2	R.K.Goyal, Practicals in Pharmacology, 6th,edition, B.S.Shah Prakashan, Ahmedabad, 2006- 2007	
3	U.K.Seth, N.K.Dadkar, Usha G.Kamat, Selected Topics in Experimental Pharmacology, 1st edition, Kothari Book Depot Mumbai, 1972	
4	Ghosh M.N, Fundamentals of Experimental Pharmacology, 3rd edition, Hilton and Co, Kolkata, 2005	
Course Outcomes (students will be able to)		
1	Record concentration response curve of acetylcholine using suitable isolated preparation by 3 types of bioassays.	

2	Understand the effect of analgesia and muscle relaxant activity of drugs using simple experiments.
3	Understand the activity of drugs on the Central Nervous System, catalepsy and catatonia.
4	Understand the importance of regulatory toxicity studies.

	Course Code:PHP1505	**Course Title: Pharmacognosy Laboratory II**	**Credits = 2**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	HSC Biology and Chemistry				
List of Courses where this course will be prerequisite					
	All pharmacognosy, phytochemistry and medicinal natural product courses				
Description of relevance of this course in B-Pharm Program					
To train the students with the basics of pharmacognosy and phytochemistry					

Sr. No.	**Course contents (Topics and subtopics)**	**Reqd hours**
1	Detailed histological studies including powder characters of barks: Cinchona and Kurchi, chemical tests and TLC development.	4
2	Detailed histological studies including powder characters of leaves : datura leaf, vasaka leaf, vinca leaf, chemical tests and TLC development	4
3	Detailed histological studies including powder characters of roots : ipecac root, rauwolfia root	4
4	Detailed histological studies including powder characters of seeds : linseed, nux vomica seed, chemical tests and TLC development	4
5	Detailed histological studies including powder characters of ephedra stem, chemical tests and TLC development.	4
6	Gross identification of drugs containing fixed oils, fats and waxes (10 drugs). Identification of fixed oils by chemical tests.	4
7	Gross identification of drugs containing carbohydrates (10 drugs). Identification of drugs by chemical tests	4
8	Gross identification of Alkaloidal drugs (20 drugs).	4
9	Identification of fibers by chemical tests and microscopy (animal, vegetable, mineral and synthetic fibers)	4
10	Separation of starch from potato tubers	4
11	Isolation of mucilage by alcohol precipitation (aloe juice)	4
12	Preparation of extract by Soxhlet extractor and evaluation of extract by for phytoconstituent by spectrophotometry. (e.g. quinine, strychnine, brucine, etc).	4
13	Extraction and isolation of piperine from blackpepper	4
14	Extraction and isolation of caffeine from tea	4
15	Visit to Medicinal plant garden	4

List of Text Books/Reference Books

1.	Dewick, Paul M. Medicinal natural products: a biosynthetic approach. 2nd edition, John Wiley & Sons, 2002
2.	Bruneton J, Pharmacognosy & Phytochemistry Medicinal Plants,2nd edition, Lavoisier Publishing Inc. 1999
3.	Harborne J.B. Phytochemical Methods- A Guide to modern techniques of Plant analysis, 3rd edition,Springer, 1998
4.	Ikan R., Natural Products- A Laboratory Guide, 2nd edition, Academic Press, 1994
5.	Tyler V.E., Pharmacognosy, 8th edition, Lea & Febiger, 1981
6.	Trease & Evans, Textbook of Pharmacognosy, 16th edition, Harcourt Publishers, 2009
7.	Wallis, Thomas Edward, Textbook of Pharmacognosy, 5th edition,J. & A. Churchill Ltd,1967
8.	Wagner, Hildebert, and Sabine Bladt. Plant drug analysis: a thin layer chromatography atlas. Springer Science & Business Media, 1996.
9.	Wealth of India (11 volumes), Publications and Information Directorate, CSIR, 1992
10.	Jackson B.P., DW.Snowdon, Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices, CBS Publishers, 1990
11.	The Merck Index, Merck Research Laboratories, 13th edition, Merck & Co., Inc, 2001

12.	Indian Pharmacopoeias, 2010, Government of India, Controller of Publications, Delhi	
13.	Ayurvedic Pharmacopoeia of India, AYUSH, CCRAS	
14.	Quality Standards of Indian Medicinal Plants, all volumes, ICMR	
15.	Indian Medicinal Plants, Kiritikar and Basu	
Course Outcome (students will be able to...)		
1	Identify plant material on the basis of its microscopical characters.	
2	Undertake separation of carbohydrates like starch and aloe gel.	
3	Undertake extraction of herbal raw material and identification of phytoconstituents in it.	
4	Undertake isolation of phytoconstituents like piperine from black pepper and caffeine from tea.	
5	Identify natural, regenerated and synthetic fibres.	

	Course Code: PHP1703	**Course Title: In Plant Training Report and Presentation and Community Service**	**Credits = 2**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 160hrs. (**4 weeks x 5 days x 8 hrs per day)	**0**	**0**	**4**
List of Prerequisite Courses					
	Pharmaceutics I, Pharmaceutics II, Pharmaceutics III and Pharmaceutics IV				
List of Courses where this course will be prerequisite					
	Pharmaceutics VII and Pharmaceutics VIII				
Description of relevance of this course in the B. Pharm. Program					
To trained the students to understand working of the pharmaceutical industry					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
1	At the end of Semester – VII students will have to spend 4 weeks in a Pharmaceutical industry and do community service for 12 hours. They will be required to submit a written report on their In-plant training. The report should consist of: (i) Major products of the company, (ii)Plant description, (iii) General plant layout, (iv)Processes for Major Products (no confidential proprietary information may be included), (v)Chemistry of processes studied (in case of chemical manufacture) based on Journal papers, Patents, Books, etc.,(vi)Safety and Health (Material Safety Data Sheets, Safety Policy), (vii)Environmental Protection (measures used and general description of the processes and facilities used), Any project assigned to you by the company (title, a short description, results and conclusions: all in less than 500 words) Students will present their work before a panel of teachers in the Institute. The report would carry 50% weightage and the presentation would carry 50% weightage		160		
Course Outcomes (students will be able to…..)					
1	Understand working of the pharmaceutical industry (GMP) documentation validation SOP, QC, QA, and IPQC.				
2	Student will contribute towards society – teaching health and hygiene , storage and usage of medicine				

FINAL YEAR B.PHARM SEMESTER VIII

	Course Code: PHT1411	**Course Title: Pharmaceutical and Medicinal Chemistry –V**	**Credits = 3**		
			L	**T**	**P**
	Semester: VIII	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Pharmaceutical and Medicinal Chemistry –IV				
List of Courses where this course will be prerequisite					
	Not Applicable				

Description of relevance of this course in the B. Pharm. Program		
To train the students with respect to basics of Steroidal Drugs, Thyroid Drugs, vitamins, drug discovery process		
	Course Contents (Topics and subtopics)	**Reqd. hours**
	Study of the following classes of drugs with respect to their classification, chemical nomenclature,structure including stereochemistry, generic names, chemistry, physicochemical properties,SAR,metabolism,molecularmechanism ofactionandsynthesisand introductionto rational development, if any.	
1	**Steroids:** a) Nomenclature and 3-D structure of steroids, Biosynthesis and metabolismof steroids. b) Corticosteroids – Glucocorticoids- systemic topical and inhaled, Mineralocorticoids. c) Male sex steroids and other related agents – Androgens and anabolic steroids, Antiandrogens, androgen biosynthesis inhibitors, Drugs for erectile dysfunction. d) Estrogens- steroidal and non-steroidal,antiestrogens, SERMs. Aromatase inhibitors, Progestins & its inhibitors.	4 4 2 4
2	**Thyroid Agents:** a) Thyroid hormone and analogs. b) Antithyroidagents	2
3	**Vitamins and their involvement in metabolism(Biochemistry of vitamins):** a) Water soluble vitamins b) Lipid soluble vitamins	4
4	Drugs for calciumhomeostasis.	2
5	**Introduction to drug discovery** a) Drug discovery fromnatural products. b) Analogue Based Drug Design, Serendipity in Drug Discovery c) Emergence of rational drug discovery	5
6	QSAR, 3D QSAR, structure and Ligand based Drug Design introduction	6
7	Enzymes and receptors in drug design.	5
8	Prodrugs	5
9	Emerging areas in medicinal chemistry. e.g. drugs based on PDEs and/or other topics of current interest.	2
List of Text Books/ Reference Books		
1	Foye, William O. Foye's principles of medicinal chemistry. Edited by Thomas L. Lemke, and David A. Williams, 6th edition, Lippincott Williams & Wilkins, 2008.	
2	Wilson, Charles Owens, and Ole Gisvold, Textbook Of Medicinal And Pharmaceutical Chemistry,11th edition, Lippincott Williams & Wilkins, Philadelphia, 2004	
3	Donald J. Abraham, David P. Rotella, Burger's Medicinal Chemistry, Drug Discovery and Development, 7th Edition, 8 Volume Set, John Wiley & Sons-New Jersey,2010	
4	Remington, Joseph Price. Remington: The science and practice of pharmacy. Edited by David B. Troy, and Paul Beringer. Vol. 1. Lippincott Williams & Wilkins, 2006.	
5	Iyer R. P.,. Degani M. S, Synthesis Of Drugs: A Synthon Approach, 2nd edition, Vol-1, Sevak Publications Pvt. Ltd., 2008	
6	Axel Kleemann and Jürgen Engel, Pharmaceutical Substances: Synthesis, Patents, Applications (N-Z) Kleemann 4th edition, Thieme, 2011	
7	Lednicer, Daniel. The organic chemistry of drug synthesis. Vol. 7. John Wiley & Sons, 2007.	
8	R. B. Silverman & Holladay, The Organic Chemistry of Drug Design And Drug Action. 3rd edition, Elsevier Publication, 2014	
Course Outcomes (students will be able to…..)		
1	Draw and understand structures and write IUPAC names of structures (includes 3D structures)	
2	Explain mechanism of action of drugs at molecular level.	
3	Understand and apply the concepts of SAR.	
4	Predict the synthetic route for simple drugs	
	Note: The above course outcomes are related to Steroidal Drugs, Thyroid Drugs, vitamins	

	Course Code:PHT 1506	Course Title: Pharmacognosy III	Credits = 3		
			L	T	P
	Semester: VIII	Total contact hours: 45	2	1	0
	List of Prerequisite Courses				
	HSC Biology and Chemistry				
	List of Courses where this course will be prerequisite				
	All pharmacognosy, phytochemistry and medicinal natural product courses				
	Description of relevance of this course in B-Pharm Program				
To train the students with the basics of pharmacognosy and phytochemistry					

Sr. No.	Course contents (Topics and subtopics)	Reqd. hours
1	**Phenyl propanoids**: Peru and Tolu Balsams, Asafoetida, Vanilla, Salicin, Capsicum*, Ginger, Benzoin, Clove, Nutmeg, Cinnamon*, Turmeric	4
2	**Coumarins** : Psoralea, Tonco , Lignans: Podophyllum, Phyllanthus,	2
3	**Flavonoids**: Fagopyrum, Orange peel, Soya isoflavone	2
4	**Terpenoids**: Ajowan, Alpinia, Abelmoschus, Anise, Amomum, Calamus, Cardamom, Caraway, Citrus oils, Coriander, Cummin, Dill, Eucalyptus oil, Fennel, Jatamansi, Lemongrass, Mints, Palmarosa, Rose, Sandalwood, Saussurea, Star anise,	5
5	Terpenoids:Turpentine, Wintergreen, Vetiver, , Valerian, Jasmine, Artemisia, Pyrethrum, Colophony, Matricaria; Taxus, Myrrh, Shellac, Quassia, Picrorhiza, Andrographis, etc	4
6	Biosynthesis of important terpenoids	2
7	**Triterpenes** : Acacia concinna, Bacopa, Colocynth, Gymnema, Hydrocotyl, Licorice*, Momordica, Quillaia, Senega, Sapiandus, etc	
8	**Cardioactive glycoside** : Digitalis*, Nerium, Strophanthus, Squill, Thevetia, etc	3
9	**Steroidal saponin**: Agave, Asparagus, Dioscorea*, Fenugreek ,Guggul, Smilax, etc	3
10	**Carotenoids**: Saffron, Bixa, -carotene, Naphthelene derivatives: Plumbago, Alkanna, Henna	3
11	**Anthraquinone**: Aloes, Andira, Cascara, Cochineal, Hypericum, Rhubarb, Rubia, Senna	3
12	**Tannins**: Black catechu, Galls*, Hammamalis, Kinos, Amla, Behera, Harda, Pale catechu.	3
13	**Polyacetytenes , Cyanophoric glycosides**: Almonds, Wild cherry	3
14	**Isothiocyanate glycosides: Mustard, Sulphur containing compounds: Garlic**	2
15	Plant Allergens, Aflatioxin	2
16	Aflatoxin, Marine drugs, Poisonous plants	2
17	Topic of current importance in the field	2

List of Text Books/Reference Books

1. Dewick, Paul M. Medicinal natural products: a biosynthetic approach. John Wiley & Sons, 2002
2. Bruneton, Jean. Pharmacognosy, phytochemistry, medicinal plants. Lavoisier publishing, 1995
3. Harborne, A. J. Phytochemical methods a guide to modern techniques of plant analysis. Springer Science & Business Media, 1998
4. Ikan, Raphael. Natural products: a laboratory guide. Elsevier, 2013
5. Tyler V.E., Pharmacognosy, 8th edition, Lea & Febiger, 1988
6. Trease & Evans, Textbook of Pharmacognosy, 16th edition, Harcourt Publishers, 2009
7. Jaiyesimi, A, and Yewande A. "Pharmacognostic Studies and Antiinflammatory Activities of Clerodendrum Volubile P Beauv Leaf." International Journal of Phytomedicine, 2013
8. Wagner, Hildebert, and Sabine Bladt. Plant drug analysis: a thin layer chromatography atlas. Springer Science & Business Media, 1996
9. Wealth of India (11 volumes), Publications and Information Directorate, CSIR, 1992
10. Jackson B.P., DW.Snowdon, Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices, CBS Publishers, 1990
11. The Merck Index, Merck Research Laboratories, 13th edition, Merck & Co., Inc. 2001
12. Indian Pharmacopoeias, 2010, Government of India, Controller of Publications, Delhi
13. Ayurvedic Pharmacopoeia of India, AYUSH, CCRAS
14. Quality Standards of Indian Medicinal Plants, all volumes, ICMR

15.	Indian Medicinal Plants, Kiritikar and Basu	
Course Outcome (students will be able to...)		
1	Know various constituents presents in plants and their application in pharmaceutical and other field.	
2	Undertake separation of volatile oil and isolation of constituents from volatile oils.	
3	Perform extraction and isolation of phytoconstituents.	
4	Understand isolation of phytoconstituent from plant and chemical modification to get useful compounds.	
5	Analyse terpenoids, glycosides and tannins.	

	Course Code: PHT1602	**Course Title: Pharmaceutical Biotechnology**	**Credits = 3**		
			L	**T**	**P**
	Semester: VIII	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	10^{th} std. Biology; 12^{th}std Chemistry				
List of Courses where this course will be prerequisite					
	Process Technology and Biotechnology Laboratory				

Description of relevance of this course in the B. Tech./B.Pharm. Program

To familiarize students with areas of biotechnology and their application in healthcare, with techniques in biotechnology involving natural, enriched and engineered microorganisms, or their components or plant/mammalian cells for production of pharmaceutically relevant compounds of industrial importance and about the structural features and functions of immune system components and their involvement in development of immune response, the use of immunological techniques as analytical tools and he principles governing vaccination

Sr. No.	Course contents (Topics and subtopics)	Reqd. hours
1	Introduction to Pharmaceutical Biotechnology and its role in healthcare and diagnostics	5
2	**Fermentation technology:** Introduction to fermentation Types of fermentation, microorganisms in fermentation, strain improvement, Fermentors and types; Stages of fermentation; typical fermentation types – batch, continuous, fed-batch; factors affecting fermentation, Typical fermenter designs and explanation of design characteristics. Examples of industrial products	 4 5 5
3	Enzyme fermentation and immobilization	2
4	Basics of immunology Immune system, humoral and cell mediated immunity Antibodies, antigen-antibody reactions Active and Passive immunity	4 4 4 3
5	Plant and animal tissue culture Techniques and applications	4 3
6	Pharmacogenomics	2
List of Text Books/Reference Books		
1	PK Gupta, Elements of biotechnology, 2^{nd} Edition, Rastogi Publications, 2015	
2	Owen JA, Punt J, Stranford SA. Kuby immunology. New York: WH Freeman; 2013	
3	Gamborg, Oluf L., and Gregory C. Phillips. "Laboratory facilities, operation, and management." In Plant Cell, Tissue and Organ Culture, pp. 3-20. Springer Berlin Heidelberg, 1995	
4	Walsh, Gary. Pharmaceutical biotechnology: concepts and applications. John Wiley & Sons, 2007	
5	Stanbury, Peter F., Allan Whitaker, and Stephen J. Hall. Principles of fermentation technology. Elsevier, 2013	
Course Outcomes (students will be able to)		
1	Explain and utilize various concepts of biotechnology in academe and research in diagnostic, therapeutic and allied industrially relevant fields of molecular biology and biotechnology	
2	Explicate and employ various concepts of fermentation and different fermentative strategies, based on natural, enriched and engineered microorganisms, or their components as well as design a simple containment system (Bioreactor / fermentor) for producing compounds of industrial importance	
3	Explicate and exploit various components of immune system and mechanisms involved in immune system	

	development and responsiveness as well as various immunological techniques to develop vaccines and vaccine formulations	
4	Elucidate and apply common cell culture techniques, e.g. callus culture, micropropagation, embryogenesis in plants and in mammalian cells to produce compounds of industrial, specifically therapeutic importance	
5	Explain how individual genetic variations affect responses to drug and formulations to be able to develop 'personalized' medicines	

	Course Code:PHT1121	**Course Title: Pharmaceutics VI**	**Credits = 3**		
			L	**T**	**P**
	Semester: VIII	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the B. Pharmacy					
In-depth knowledge of sterile pharmaceuticals, ophthalmic products, blood and blood substituents, sutures and ligatures.					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	Oral sustained and controlled release formulations: Terminologies, basic principles and mechanisms of sustained drug release, materials and methods, large scale manufacture, evaluation and quality control, packaging	3
2	Novel oral DDS: Gastro retentive DDS, Osmotic DDS, Pulsatile DDS, Colonic DDS	7
3	Introduction to principles and concepts of transdermal, transmucosal, ocular and targeted delivery	4
4	CGMP, and quality assurance	2
5	Documentation	3
6	Qualification and validation: Types of validation, product and process validation	4
7	Schedule M: Factory layout, focus on department layouts, services etc.	3
8	Pilot plant scale up technique – groups responsibilities, facilities, example of scaling up of liquid/solid oral formulations, biobatch preparation	3
9	Production management, total quality management, materials, inventories, ABC concept, EOQ, Cost controls	3
10	IPR: Introduction to Indian patent law, Gatt, WTO, TRIPS, Types of patents, Introduction to patents, parts of a patent	3
11	NDA and ANDA filing, CDER guidelines	2
12	ICH guidelines	6
13	Packaging: Primary packaging materials including glass, plastics, rubber, materials for strip and blister packaging, specifications, testing, selection, compatibility evaluation, advantages and limitations; secondary and tertiary packaging materials	2
List of Text Books/ Reference Books		
1	L. Lachman, Herbert A. Lieberman and J. kanig, Theory and practice of Industrial Pharmacy, 3rd edition, Lea and Febiger, Philadelphia, 1987	
2	Herbert A. Liberman, Martin A. Rieger, G.S. Banker, Pharmaceutical Dosage Form: Dispersed Systems (vol. 1 & 2), 2nd edition, Marcel Dekker Inc. 1993	
Course Outcomes (students will be able to…..)		
1		
2		
3		

	Course Code: PHP1404	Course Title: Medicinal Chemistry Laboratory	Credits = 2		
			L	T	P
	Semester: VIII	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
	Organic chemistry Laboratory I and II, Pharmaceutical Chemistry Laboratory I				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the B. Pharm. Program					
To train the students in standard laboratory practices with respect to safety, understand qualitative analysis of organic molecules					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Multistep drug synthesis a) acetanilide to sulphanilamide. b) p-nitro toluene to benzocaine	5*4
2	Synthesis of analogs e.g. series of esters from suitable carboxylic acids	2*4
3	Experimental determination of pKa and comparison with software generated data	2*4
4	Experimental determination of log P values and comparison with software generated data	2*4
5	Experimental determination of simple in-vitro activity of analogs	4
6	Structure property relationship from experimental data	4
7	Demonstration of pharmacophore development and QSAR	4
8	Demonstration of structure based drug design	4
	List of Text Books/ Reference Books	
1	Furniss, Brian S. Vogel's textbook of practical organic chemistry, Pearson Education India,	
2	J. Leonard, trvor P. Toube, B. Lygo, G Advanced Practical Organic Chemistry. Proctor, 2nd edition, Stanley Thornes. 1990	
3	Keese, R, Martin P. B, and Trevor P. Toube. Practical organic synthesis: a student's guide. John Wiley & Sons, 2006.	
	Course Outcomes (students will be able to…..)	
1	Work safely in the organic chemistry laboratory and synthesize drugs using multiple steps	
2	Compare physicochemical properties using experiments and software	
3	Predict SARs	
4	Understand basic drug design software and its applications	

	Course Code: PHP1117	Pharmaceutics Laboratory V	Credits = 2		
			L	T	P
	Semester: VIII	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
	Pharmaceutics Laboratory IV				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the B. Pharmacy					
To train the students with respect to practical aspects of modified release pharmaceutical formulation development and quality control thereof					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Representative examples of sustained release formulations Preparatuion of matrix tablets and multiparticulates by different methods, Reservoir systems,	16
2	Documentation required during scale up studies	8
3	Representative examples of novel drug delivery systems e.g. floating, pulsatile and osmotic drug delivery	20

	system	
4	Accelerated stability testing and shelf life determination	8
5	Calculation of pharmacokinetic parameters. Problem solving sessions with t max, C max, AUC, and other pharmacokinetic parameters.	8
Course Outcomes (students will be able to…..)		
1	Perform accelerated stability studies and calculate shelf life	
2	Formulate and evaluate oral sustained release matrix tablets and multiparticulate dosage form	
3	Prepare floating, pulsatile and osmotic drug delivery system	
5	Document related records to manufacture and quality control	
6	Calculate pharmacokinetic parameters and bioavailability	

	Course Code:PHP1506	**Course Title: Pharmacognosy Laboratory III**	**Credits = 2**		
			L	**T**	**P**
	Semester: VIII	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	HSC Biology and Chemistry				
List of Courses where this course will be prerequisite					
	All pharmacognosy, phytochemistry and medicinal natural product courses				
Description of relevance of this course in B-Pharm Program					
To train the students with the basics of pharmacognosy and phytochemistry					

Sr. No.	**Course contents (Topics and subtopics)**	**Reqd. hours**
1	Detailed histological studies including powder characters of rhizomes: Ginger and Glycyrrhiza	4
2	Detailed histological studies including powder characters of fruits : Coriander and Fennel	4
3	Detailed histological studies including powder characters of leaves : Senna and Digitalis	4
4	Detailed histological studies including powder characters of Cinnamon bark and Quassia wood	4
5	Detailed histological studies including powder characters of Clove and Cardamom	4
6	Gross identification of drugs containing volatile oils (20 drugs)	4
7	Gross identification of drugs containing steroids and triterpenoiods (10 drugs)	4
8	Gross identification of anthraquinones, tannins, lignan and coumarin, etc. containing drugs (10 drugs)	4
9	Evaluation of unorganised drugs mentioned under theory by chemical tests	4
10	Separation of volatile oil from crude drug (e.g. clove, eucalyptus, etc)	4
11	Isolation of embellin, and or ellagic acid	4
12	Isolation of aloe emodin and or diosgnin	4
13	Isolation of eugenol, etc	4
14	Demonstration of column chromatography and preparative TLC	4
15	Preparation of herbarium sheet	4

List of Text Books/Reference Books

1.	Dewick P.M., Medicinal Natural Products- A Biosynthetic Approach,2nd edition/2002, John Wiley & Sons Ltd
2.	Bruneton J. Pharmacognosy & Phytochemistry Medicinal Plants,2nd edition/1999, Lavoisier Publishing Inc.
3.	Harborne J.B. Phytochemical Methods- A Guide to modern techniques of Plant analysis, 3rd edition/1998,Springer
4.	Ikan R., Natural Products- A Laboratory Guide, 2nd edition/1994, Academic Press
5.	Tyler V.E., Pharmacognosy, 8th edition/1981, Lea & Febiger
6.	Trease & Evans, Textbook of Pharmacognosy, 15th edition/2002, Harcourt Publishers
7.	Wallis, Textbook of Pharmacognosy, 5th edition/1967,J. & A. Churchill Ltd.
8.	Wagner H., Plant Drug Analysis- A Thin Layer Chromatography Atlas 1984,Springer-Verlag
9.	Wealth of India (11 volumes), Publications and Information Directorate, CSIR, 1992
10.	Jackson B.P., DW.Snowdon, Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices, 1990,CBS Publishers

11.	The Merck Index, Merck Research Laboratories, 13th edition, 2001, Merck & Co., Inc	
12.	Indian Pharmacopoeias, 2010, Government of India, Controller of Publications, Delhi	
13.	Ayurvedic Pharmacopoeia of India, AYUSH, CCRAS	
14.	Quality Standards of Indian Medicinal Plants, all volumes, ICMR	
15.	Indian Medicinal Plants, Kiritikar and Basu	
Course Outcome (students will be able to...)		
1	Identify unorganised drugs on the basis of its chemical reactions.	
2	Undertake separation of volatile oil from plant material.	
3	Perform isolation of phytoconstituents like embellin,anthraquinones, ellagic acid etc.	
4	Undertake separation of constituents by column chromatography.	
5	Detection of adulterants by physical and chemical test methods.	

	Course Code: PHP1704	**Course Title: Home Paper**	**Credits = 2**		
			L	**T**	**P**
	Semester: VIII	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	All courses relevant to the home paper given				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the B. Tech. Program					
The course familiarizes the students with identification of problems related to course work, literature collection and analysis, and deriving a solution for the same.					

Sr. No.	**Course contents (Topics and subtopics)**	**Reqd. hours**
1	Identify a problem related to a given topic in line with their coursework in any discipline of pharmacy	
2	Define a hypothesis based on scientific literature	
3	Conceptualise a theoretical solution and present it as a written report	
4	Defend questions related to the solution of the problem	
	Course Outcomes (students will be able to…)	
1	Use literature effectively to arrive at a theoretically valid solution	
2	Compile the literature, hypothesis and solution	
3	Defend the hypothesis and solution	

ELECTIVES

	Course Code: PHT1095	Course Title: Intellectual Property Rights	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45 Hrs	2	1	0
	List of Prerequisite Courses				
	NIL				
	List of Courses where this course will be prerequisite				
	NIL				
	Description of relevance of this course in the B. Tech (Pharma)				
To train the students with respect to basics of Intellectual Property Rights					
	Course Contents (Topics and subtopics)		Reqd. hours		
1	Introduction to Intellectual Property: overview describing definition, need and evolution		2		
2	IPR related laws: Biodiversity		2		
3	Introduction to WIPO and Treaties under WIPO		6		
4	**Type of Intellectual Property: Copyright** Introduction, Process of filing, rights achieved		4		
5	**Type of Intellectual Property: Trademarks** Introduction, Process of filing, rights achieved		4		
6	**Type of Intellectual Property: Geographical Indication** Introduction, Process of filing, rights achieved		3		
7	**Type of Intellectual Property: Industrial design** Introduction, Process of filing, rights achieved		3		
8	**Type of Intellectual Property: Trade secret** Introduction, Process of filing, rights achieved		3		
9	**Type of Intellectual Property: patent** Introduction Patent and traditional knowledge Indian patent Act Process of filing Rights achieved		6		
10	Patentability w.r.t. regional requirements		2		
11	Patent filing under Paris Convention Treaty (PCT)		5		
12	Role of IPR in Pharmaceuticals		5		
	List of Text Books/ Reference Books				
1. All documentation from World Intellectual Property Organization (www.wipo.int) 2. Indian Patent Act (www. ipindia.nic.in) 3. Pharmaceutical Product Development: Insights into Pharmaceutical Processes, Management and Regulatory Affairs, Patravale V, Rustomjee M, Dsouza J. 2016, CRC press					
	Course Outcomes (students will be able to…..)				
1	Explain various types of Intellectual Property Rights				
2	Explain importance of Intellectual Property Rights in relevance to Pharmaceuticals				

	Course Code: PHT1094	Course Title: Regulatory Requirements for Pharmaceuticals	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45 Hrs	2	1	0
	List of Prerequisite Courses				
	Pharmaceutical Formulation Technology III				
	List of Courses where this course will be prerequisite				

	NIL	

Description of relevance of this course in the B. Tech (Pharma)

To train the students with respect to basics of regulatory requirements of pharmaceuticals

	Course Contents (Topics and subtopics)	Reqd. hours
1	**Schedule governing pharmaceutical product development (e.g. Schedule M , Schedule Y)**	3
2	**ICH guidelines Q8(R2), Q9, Q10, Q11 and Q12**	5
3	**Documentation for pharmaceuticals**	3
4	**Introduction to regulatory aspects of pharmaceuticals** • Introduction to Regulatory aspects of pharmaceuticals, need, advantages and limitation • Introduction to major regulatory bodies worldwide • Rationale for regulatory harmonization and introduction of ICH • Introduction to CTD Modules	5
5	**Drug Master file (DMF)**	2
6	**Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: Investigational New Drug Application (IND)-** filing, review, approval process and representative case studies	3
7	**Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: New Drug Application (NDA) [505(b) (1) and (b) (2)]-** filing, review, approval process and representative case studies	4
8	**Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: Abbreviated New Drug Application (ANDA) 505 (j)-** filing, review, approval process and representative case studies	5
9	**Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: New Animal Drug Application (NADA)-** filing, review, approval process and representative case studies	2
10	**Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: Abbreviated New Animal Drug Application (ANADA)-** filing, review, approval process and representative case studies	2
11	**Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: Biological License Application (BLA)-** filing, review, approval process and representative case studies	2
12	Comparison of Indian, European and rest of the world Regulatory procedure for pharmaceutical product market approval in comparison to USFDA guidelines	4
13	**Legal acts** • DPCO • Drugs and cosmetics act • Rules including licensing intermediates industry	5

List of Text Books/ Reference Books

1. Beotra's Law of Drugs Medicins and Cosmetics K. K. Singh, L. R. Bugga for the Law Book Co. Pvt. Ltd. Allahabad
2. Modern Pharmaceutics, G. S. Banker, New York, Marcel Dekker 1990
3. Fundamentals of Pharmacy, Blome H. E., Philadelphia, Fea and Febiger, 1985
4. Pharmaceutical Production Facilities: Design and Applications, G. C. Cole, New York Ellis Horwood 1990
5. Drug Delivery Devices: Fundamentals and Applications Tyle, New York, Marcel Dekker 1988
6. Microbial Quality Assurance in Pharmaceuticals Cosmetics and Toiletries, S. F. Bloomfield, Chichester, Ellis, Horwood, 1998.
7. Encyclopedia of Pharmaceutical Technology, J. Swarbrick, New York, Marcel Dekker, 1993
8. Remington's Pharmaceutical Sciences, A. R. Gennaro Mac Pub. Co. Easton, Pennsylvania 1990
9. Pharmaceutical Product Development: Insights into Pharmaceutical Processes, Management and Regulatory Affairs, Patravale V, Rustomjee M, Dsouza J. 2016, CRC press
10. Indian Pahrmacopoiea, British Pahrmcopoiea, United States Pharmcopoiea.
11. Oral Mucosal Drug Delivery, Rathbone, New York, Marcel Dekker, 1996
12. Good Laboratory Practice Regulations A. F. Hirsch, New York, Marcel Dekker, 1989
13. Good Laboratory Practice Regulations Weinberg New York, Marcel Dekker, 1995.

Course Outcomes (students will be able to…..)

1	Explain the regulatory pathways for new drug application and generic product development	
2	Explain Drugs and Cosmetics act, Drug price control order and regulations therein	

	Course Code: PHT1096	Course Title: Cosmetic Delivery Systems	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45 Hrs	2	1	0

List of Prerequisite Courses		
	NIL	

List of Courses where this course will be prerequisite		
	NIL	

Description of relevance of this course in the B. Tech (Pharma)

To train the students with respect to basics and advances of cosmetic delivery systems

	Course Contents (Topics and subtopics)	Reqd. hours
1.	**Introduction to cosmetic delivery systems and cosmeceuticals and basic consideration:** • Definition of cosmeceuticals • Advantages • Market overview • Current trends in cosmeceuticals w.r.t. nanotechnology and delivery platforms	5
2	**Vesicular Delivery systems (Introduction, Formulation, applications and advances):** • Liposomes • Transferosomes • Niosomes • Phytosomes • Miscellaneous vesicular systems	8
3	**Particulate Systems (Introduction, Formulation, applications and advances):** • Porous polymeric systems • Polymeric micro/ nanoparticulate systems	8
4	**Emulsion Delivery Systems (Introduction, Formulation, applications and advances):** • Colloidal delivery systems • Micro/nano and multiple emulsions • Liquid crystals	8
5	**Other Delivery systems (Introduction, Formulation, applications and advances):** • Cyclodextrin complexes • Carbosomes • Dendrimers • Nano Crystals	8
6	**Delivery Devices (Introduction, Formulation, applications and advances):** • Iontophoresis • Microneedles • Cosmetic patches	8

List of Text Books/ Reference Books

1. Recent research and review articles from literature
2. Advances in dermatological Sciences, 2013, R. P. Chilcott, Keith R. Brain, Royal Society of Chemistry
3. Harry's Cosmeticology, Rieger 8th edition, 2000, Leonard Hill Book & Intertext Publisher, London

Course Outcomes (students will be able to…..)		
1	Explain concept of cosmetic delivery systems and cosmeceuticals	
2	Explain recent advances in Cosmeceuticals	

	Course Code: PHT1097	Course Title: Applied Molecular Biotechnology	Credits = 3		
			L	T	P
	Semester: VII	Total contact hours: 45	2	1	0

List of Prerequisite Courses		
	Molecular Biology and Biotechnology	
List of Courses where this course will be prerequisite		
	None	
Description of relevance of this course in the B. Tech./B.Pharm. Program		
To Introduce students to advanced genetic techniques employed to design molecular diagnostic kits and protein therapeutics and to familiarize students with the procedures involved in genetic engineering of plants and animals		
Sr. No.	**Course contents (topics and subtopics)**	**Reqd. hours**
1	Molecular diagnostics: Immunological diagnostic procedures, nucleic acid diagnostic systems, molecular diagnosis of genetic disease	5
2	Protein therapeutics: Biopharmaceuticals, enzymes, monoclonal and recombinant antibodies	5
3	Nucleic acids as therapeutic agents	5
4	Vaccines: Subunit vaccines, peptide vaccines, DNA vaccines, attenuated vaccines	5
5	Synthesis of commercial products by recombinant microorganisms: Enzymes, antibiotics, biopolymers; synthetic biology routes for biopharmaceuticals	5
6	Large-scale production of proteins from recombinant microorganisms	5
7	Bioremediation and biomass utilization: Microbial degradation of xenobiotics, genetic engineering of biodegradative pathways, utilization of starch, sugars and cellulose	5
8	Genetic engineering of plants	5
9	Transgenic animals	5
	List of Text Books/Reference Books	
1	Molecular Biotechnology: Principles and Applications of Recombinant DNA, by Glick and Paternak 3rd edition, 2003, ASM Press	
2	Principles of gene manipulation : an introduction to genetic engineering / R.W. Old, S.B. Primrose, 5th Edition, 1994, Blackwell Scientific	
3	Gene Cloning and DNA Analysis: An Introduction, T A Brown, 7th Edition, 2015, Wiley-Blackwell	
	Course Outcomes (students will be able to)	
1	Describe the procedures involved in designing molecular diagnostic kits	
2	Design strategies to synthesize biological products using recombinant microbial host cells	
3	Use the knowledge of microbial metabolic processes to carry out genetic engineering of microbes to degrade recalcitrant material	
4	Apply different protocols available for genetic engineering of plants and animals	

	Course Code: PHT1098	**Course Title: Biomaterials: Biodegradable Materials for Biomedical Applications**	**Credits = 3**		
			L	**T**	**P**
	Semester:	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	10th std. Biology; 12th std Chemistry, 12th standard Physics				
List of Courses where this course will be prerequisite					
	NA				
Description of relevance of this course in the B. Tech./B.Pharm. Program					
This class provides an introduction to the interactions between cells and the surfaces of biomaterials. The course covers: surface chemistry and physics of selected metals, polymers, and ceramics; surface characterization methodology; modification of biomaterials surfaces; quantitative assays of cell behavior in culture; biosensors and microarrays; bulk properties of implants; and acute and chronic response to implanted biomaterials. General topics include biosensors, drug delivery, and tissue engineering.					
Sr. No.	**Course contents (Topics and subtopics)**		**Reqd. hours**		
1	Introduction of Biomaterials		2		
2	**Biomaterials Surfaces:** Structure and Properties, Surface Energy, Adsorption and Reconstruction at Surfaces		4		
3	**Protein-Surface Interactions**: Proteins: Structure, Properties, Functions, Protein Adsorption: Complex Phenomena, Measurement		4		
4	**Cell-Surface Interactions: Host Response to Biomaterials:** Cell adhesion mechanism, coagulation cascade, immune response		4		
5	**Surface Characterization:**		2		

	AES, XPS, AFM, Contact Angle	
6	**Quantifying Cell Behavior:** Cell Culture, Cellular Assays	2
7	Biosensors and Diagnostic devices	2
8	**Drug Delivery:** Controlled Release, Diffusion Controlled and Membrane based devices, Mechanical Pumps	3
9	Biomaterial for Organ Replacement Mechanical Properties, Bone Substitutes	3
10	**Introduction of Tissue Engineering:** Cell, Scaffold design, Artificial liver, pancreas, cartilage	2
11	Regulatory overview	2
	List of Text Books/Reference Books	
1	Ratner, Buddy D., et al. Biomaterials Science: An Introduction to Materials in Medicine. 2nded. Burlington, MA: Academic Press, 2004. ISBN: 9780125824637	
	Course Outcomes (students will be able to)	
1	Apply engineering principles to understand and predict the behavior of biological and physiological systems relevant to human health and disease	
2	Explicate and employ theory of biomedical engineering design and technology creation	
3	Explicate and exploit various biomaterials and their properties	
4	Elucidate protein biomaterial interactions	
5	Explain and apply characterization methods for biomaterials and biomaterial-protein interactions	

	Course Code: PHT1099	Course Title: Drug Synthesis Approaches	Credits = 3		
			L	T	P
	Semester: VII	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Organic Chemistry-I, Organic Chemistry-II,Pharmaceutical Organic Chemistry				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the B. Pharm. Program					
To train the students with respect to organic, catalytic and biocatalytic techniques for the synthesis of drug and intermediate; routes for chiral synthesis/chiral separation; use of protecting groups in synthesis and derivatization of natural products					
	Course Contents (Topics and subtopics)		**Reqd. hours**		
1	**Retrosynthetic Approaches**				
	Recap of basic concepts of retrosynthetic analysis		3		
	Building blocks in drug synthesis		2		
	Cabon-heteroatom bond disconnections, with examples		3		
	Carbon-carbon bond disconnections, with examples		4		
	Synthesis of drug molecules by multiple approaches in the following classes of drugs (involving 3 or more steps):				
	a. Anti-infective (2 molecules)		2		
	b. CNS drugs (2 molecules)		2		
	c. CVS drugs (2 molecules)		2		
	d. Anti-diabetic drugs (2 molecules)		2		
	e. Anti-histaminics (2 molecules)		2		
	f. Anticancer compounds (2 molecules)		2		
	g. NSAIDS (2 molecules)		2		
	h. Miscellaneous Drugs (2 molecules)		2		
2	Asymmetric synthesis, resolution of enantiomers applicable to drug synthesis		4		
3	Derivatization of natural products		4		
4	Biocatalysis		2		
5	Catalysis synthesis		3		
6	Protecting groups in organic synthesis		4		
List of Text Books/ Reference Books					
1	Warren S. and Wyatt P., Organic Synthesis- The Disconnection Approach, 2nd edition; John Wiley & Sons-Chichester, 2008.				
2	Louden M., Organic Chemistry, 5th edition, Roberts and Company Publishers, 2009.				
3	Carey F., Organic Chemistry, 9th edition, McGraw-Hill Education, 2013.				
4	Corey E.J.,Logic of Chemical Synthesis, Wiley-Blackwell; Revised ed., 1995.				
5	Iyer RP and Degani M.S, Synthesis of Drugs: A synthon Approach Vol-1, 2nd Ed. Sevak publications Pvt. Ltd				
Course Outcomes (students will be able to…..)					
1	Apply organic synthesis principles for drug and intermediate synthesis				
2	Predict methods and routes for chiral synthesis/chiral separation				
3	Apply catalytic and biocatalytic techniques for the synthesis of drugs and intermediates				
4	Understand how to derivatize natural products				
5	Apply the use of protecting groups in synthesis				

	Course Code: PHT1091	Course Title: Nanoscience and Technology	Credits = 3		
			L	T	P
	Elective	Total contact hours: 45 hrs	2	1	0
	List of Prerequisite Courses				
	NIL				
	List of Courses where this course will be prerequisite				
	NIL				
	Description of relevance of this course in the B. Tech (Pharma)				
To train the students with respect to basics of nanoscience and application ofnanotechnology					
	Course Contents (Topics and subtopics)		Reqd. hours		
1	Introduction to nanotechnology • Definition • Classification of nanostructures and systems • Pharmaceutical applications		4		
2	**Nanoscale properties as a function of size** structural properties, chemical properties, mechanical properties, thermal properties, optical properties, magnetic properties, electronic properties		5		
3	**Fabrication methods(general approaches)** Top-down, bottom-up and templating approaches		5		
4	**Characterization methods** Imaging(microscopy) methods, analysis(spectroscopy) methods, size measurements, zeta potential measuremts etc		5		
5	**Self-assembling nanostructures** Principle of self assembly(non-covalent inter actions and intermolecular packing)		4		
6	**Polymeric vesicular and micellar nanocarriers** Preparation, properties characterization and pharmaceutical/healthcare applications		5		
7	**Nanofilms** Preparation, properties characterization and pharmaceutical/healthcare applications		4		
8	**Dendrimers** Preparation, properties characterization and pharmaceutical/healthcare applications		4		
9	**Colloidal lipid nanocarriers** Preparation, properties characterization and pharmaceutical/healthcare applications		5		
10	**Gold and silver Nanoparticles** Preparation, properties characterization and pharmaceutical/healthcare applications		4		
	List of Text Books/ Reference Books				
	1. Nanoscale Sciecne and Technology; R. Ke;sall, I. Hamley, M. Geoghegan; 2. Nanobiotechnology (Concepts, applications and perspectives); C.M. Niemeyer and C.A. Mirkin; 3. Nanotechnology in catalysis Vol 1 & 2, B. Zhou, S. Hermans and G.A. Somorjai; 4. Nanoparticulate drug delivery: A Perspective on the transition from laboratory to market, Patravale V., P. Dandekar P., Jain R., 2012 , Woodhead Publishing 5. Targeted Drug Delivery: Concepts and Design; P. Devarajan; S. Jain; 2015, Springer Publications 6. Teacher shall prescribe some latest review articles.				
	Course Outcomes (students will be able to…..)				
1	Understand basic concepts of nanotechnology				
2	Explain fabrication methodologies for polymeric, inorganic, lipidic nanoparticles generation				
3	Explain nanoscale properties and characterization thereof				
4	Justify use of nanotechnology for various applications				

	Course Code:PHT1093	Course Title: Structural Analysis by Spectroscopy	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45	2	1	0
	List of Prerequisite Courses				
	Basic knowledge of absorption spectroscopy; Mass spectroscopy; Under gone courses in instrumental methods of analysis				

List of Courses where this course will be prerequisite		
Description of relevance of this course in the B. Tech. Program		
To train the students in the analytical methods like NMR, IR, UV		
	Course Contents (Topics and subtopics)	**Reqd. hours**
1	UV-VIS spectroscopy and identification of chromophore	4
2	IR spectroscopy - correlation of absorption frequencies and fuctional groups. General analysis of IR spectrum	5
3	Proton NMR spectroscopy correlation of chemical shift of a proton with respect to structure. H-H Coupling and J values, On the basis of chemical shift, coupling constants, IR and UV information elucidation of structure of simple molecules	6
4	Mass spectroscopy, fragmentation, isotope mass	6
5	Problem solving using the above spectroscopy	5
6	^{13}C-NMR, Chemical Shift correlation, C-H coupling, NOE, DEPT, other techniques to identify p,s,t, and quaternary carbon	4
7	Problem solving using all the spectroscopies studied above	5
8	Multidimentional NMR COSEY, NOSEY, and other and structure information generation. With illustrative examples; P, N, and F NMR introduction	5
9	Problem solving	5
List of Text Books/ Reference Books		
1	Application of absorption spectroscopy of organic Compounds, John R. Dyer, Prentice Hall, India 1987.	
2	Application of absorption spectroscopy of organic Compounds, John R. Dyer, Prentice Hall, India 1987.	
3	Organic Spectroscopy, W. Kemp, 3	
4	Spectroscopic Identification of Organic Compounds by R.M. Silverstein, G.C. Basslrer, Morill T.C.; John Wiley and Sons 1991.	
	Course Outcomes (students will be able to…..)	
1	Apply uses of IR in functional group detection	
2	Apply uses of NMR in structural elucidation	
3	Apply uses of Mass spectrometry in predicting structure of comp	
4	Apply combined use of UV, IR, NMR, Mass spectra in structural elucidation	

	Course Code:PHT1100	**Course Title: SOCIAL AND PREVENTIVE PHARMACY**	**Credits = 3**		
			L	**T**	**P**
	Semester:	**Total contact hours: 45**	**3**	**1**	**0**
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					

Description of relevance of this course in the B. Tech. Program		
To introduce to students a number of health issues and their challenges. This course also introduced a number of national health programmes. The roles of the pharmacist in these contexts are also discussed.		
	Course Contents (Topics and subtopics)	**Reqd. hours**
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. Social and health education: Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention. Sociology and health: Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health Hygiene and health: personal hygiene and health care; avoidable habits	10
2	**Preventive medicine:** General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse	10
3	**National health programs, its objectives, functioning and outcome of the following:** HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, National programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.	10
4	National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program	8
5	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.	7
List of Text Books/ Reference Books		
1	Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2 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, 6Edition, 2014, ISBN: 9789351522331, JAYPEE Publications	
4	Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2 nd Edition, 2012, ISBN: 9789350250440, JAYPEE Publications	
5	Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS.	
6	Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad	
	Course Outcomes (students will be able to…..)	

	Course Code:PHT1101	Course Title: QUALITY CONTROL AND STANDARDIZATION OF HERBALS	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45	3	1	0

	List of Prerequisite Courses	

	List of Courses where this course will be prerequisite	

Description of relevance of this course in the B. Tech. Program

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

	Course Contents (Topics and subtopics)	Reqd. hours
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	10
2	Quality assurance in herbal drug industryof cGMP, GAP, GMP and GLP intraditional system of medicine. WHO Guidelines on current good manufacturing Practices (cGMP)for Herbal Medicines. WHO Guidelines on GACP for Medicinal Plants.	10
3	EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines	10
4	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.	8
5	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	7

List of Text Books/ Reference Books

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
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
12	WHO. Guidelines on Good Agricultural and Collection Practices (GACP)for Medicinal Plants. World Health Organization, Geneva, 2004.

	Course Outcomes (students will be able to…..)	

	Course Code:	Course Title: DIETARY SUPPLEMENTS AND NUTRACEUTICALS	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45	3	1	0
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the B. Tech. Program					
The subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.					

	Course Contents (Topics and subtopics)	Reqd. hours
1	a. Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc. b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community. c. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds	7
2	Phytochemicals as nutraceuticals: Occurrence and characteristic features(chemical nature medicinal benefits)of following a)Carotenoids- a and ß-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.	15
3	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..	7
4	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, a- Lipoic acid, melatonin Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole. c)Functional foods for chronic disease prevention	10

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

	Course Code:	**Course Title: Experimental Pharmacology**	**Credits = 3**		
			L	**T**	**P**
	Semester:	**Total contact hours: 45**	**3**	**1**	**0**
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the B. Tech. Program					
This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.					
	Course Contents (Topics and subtopics)		**Reqd. hours**		
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.		8		

2	**Preclinical screening models** a. Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. b. **Study of screening animal models for** Diuretics, nootropics, anti-Parkinson's,antiasthmatics, **Preclinical screening models:** for CNS activity- analgesic, antipyretic,anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease	10
3	**Preclinical screening models:** for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics	
4	**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.	
5	**Research methodology and Bio-statistics** Selection of research topic, review of literature, research hypothesis and study design Pre-clinical data analysis and interpretation using Students 't' test and One-way ANOVA. Graphical representation of data	5
	List of Text Books/ Reference Books	
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	
	Course Outcomes (students will be able to…..)	