**INSTITUTE OF CHEMICAL TECHNOLOGY**

**Degree of Bachelor of Pharmacy - Proposed 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 beingrevised.

There were several motivations for the syllabus revision:

* AICTE / NBA accreditation guidelinesrequire
  + syllabus to be benchmarked with respect to otherInstitutions
  + program objectives to be defined for thecourse
  + course objectives to be defined for eachsubject
  + map showing how the course objectives meet the programobjectives
  + map showing the linkage between differentcourses
* The B. Pharm. syllabus, especially, the first and second year contents need to be revised taking into account the syllabus for the current 12th examinations of various eligible board exams, and the CET entrance exam for MaharashtraState.
* The Pharmacy Council of India have guidelines for framing the syllabus, which have been taken into account in thisrevision.

Detailed discussions were conducted by the Department and Programme Education Objectives (PEO) were defined, in line with the vision and mission of the department. Program outcomes, defined by the National board of Accreditation, for Pharmacy students, were also taken intoaccount.

* 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 academicInstitutions.
  + Syllabus needs to have more electives and flexibility for student to choose courses as per liking, electives can be grouped to form one area ofexpertise
  + Basic science concepts need to be strengthened, and applications of these to pharmacy related courses has to beemphasised.
  + Communication skills, Interpersonal skills, team work need to bestrengthened.
  + Knowledge in management related subjects need to be enhanced; e.g. finance, human resource, IP,etc.

The weightages of different modes of assessments are defined by ICT and shall be as under.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | In-Semester evaluation | |  |  |
|  | Continuous Assessment (C. A.) | One Mid 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 closedbook),homeassignments, group assignments, viva-voce, group projects and assignments, etc. |
| Practicals | 50% | - | 50% | Attendance, *viva-voce*, journal, assignments, project, experiments, tests, etc. |

**Students’ Evaluation:**

1. It is expected that the teacher would conduct at least two assessments as a part of continuous assessment in aSemester
2. 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 continuousassessment
3. 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-semesterexamination.
4. For the theory courses, two mid-semester tests for each course will be held as per the schedule fixed in the AcademicCalendar.

(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.

1. 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 eachsemester.
2. 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 hoursduration.

**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 |
| HUT1102 | 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 | 4 | 3 | 1 | 0 | 20 | 30 | 50 | 100 |
| PHT 1211 | Pharmacology-III | 3 | 2 | 1 | 0 | 10 | 15 | 25 | 50 |
| PHT 1504 | Pharmacognosy-I | 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 | 25 | - | 25 | 50 |
|  | TOTAL | 24 | 11 | 5 | 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 |
| 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 | 25 | - | 25 | 50 |
|  | TOTAL | 26 | 12 | 6 | 16 |  |  |  | 500 |

**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 | 4 | 3 | 1 | 0 | 20 | 30 | 50 | 100 |
| PHT 1213 | Clinical Pharmacy and Drug Interactions | 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 |
| 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 | 50 | - | 100 | 150 |
|  | TOTAL | 22 | 9 | 4 | 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. | | 12 | | |
| **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. | | 15 | | |
| **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. | |  | | |

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| --- | --- | --- | --- | --- | --- |
|  | **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. No.** | **Course Contents (Topics and subtopics)** | | **Reqd. hours** | | |
| **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 H2, Addition of HX, halogens in water, H2SO4, H2O, free radicals, alkenes(dimerization), alkanes (alkylation), ozonolysis, Michael addition, Simmons-Smith reaction, epoxidation, halogenation by allylic substitution, hydroboration oxidation, oxymercuration–demercuration, oxidation using KMnO4& OsO4 | |
|  | 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, H2O, 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 | |  | | |

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| --- | --- | --- | --- | --- | --- |
|  | **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 | |  | | |

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|  | **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 | |  | | |

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|  | **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. | |  | | |

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|  | **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 | |  | | |

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|  | **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:   * 1. Fire and burns   2. Spillage   3. Inhalation of toxic fumes   4. Dress code in a laboratory   5. First aid measures to be taken in cases of accidents   6. Use of fume hood, eye shower, body shower. | | **~~4~~** | | |
| **2** | Techniques for Organic spotting:   1. Melting point and boiling point determination 2. elemental analysis 3. Functional group detection 4. 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 | |  | | |

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|  | **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**

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|  | **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 SN1and SN2 reactions, SNi 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, PX3, 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 Na2S2/NH4S6,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 (NH3)2, KMnO4, K2Cr2O7, NaOH/I2, reduction with H2/Pt or Ni or Pd, LiAlH4, NaBH4, Clemmensons and Wolf Kishner Reduction. Nucleophilic additions like cyanohydrins, acetal formation, Grignard, derivatives of ammonia, NaHSO3, 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 SOCl2, PCl3, PCl5, SO2Cl2, 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 LiAlH4, 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, SeO2, V2O5, lead tetraacetate, Oppenaur oxidations.  Catalytic hydrogenation, Clemmenson reduction, hydrazine, borohydrides,LAH,SnCl2,MPV reduction,S and Se, dissolving metal reductions, Na/alcohol, Na/Liq.NH3, 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 | |  | | |

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|  | **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 | |  | | |

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|  | **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 | |  | | |

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|  | **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, O2,CO2carriage, 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 | | | | | |

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|  | **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 | |  | | |
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| **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**  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 | | 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 | |  | | |

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|  | **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 | |  | | |

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|  | **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 | |  | | |

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|  | **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 | |  | | |

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|  | **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. | | 4 | | |
| **2** | Standardization of analytical weights and calibration of balances and volumetricapparatus. | | 4 | | |
| **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 KMnO4, 0.1 N Na2S2O3, 0.1 N AgNO3, 0.1N HClO4, 0.05 M disodium EDTA, 0.1 N CH3ONa, 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** | Physicochemical Methods\*\*  – specific gravity and density, solubility, viscosity, melting, congealing, and boiling temperatures. | | 4 | | |
|  | \*\*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**

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|  | **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: SN1,SN2,E1,E2 and E1cb reactions,syn and anti-additions of H2 to alkynes, addition of halogens(X2),halohydrin formation (X2 and H2O); KMnO4,OsO4 and alkaline H2O2 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 | | 5 | | |
|  | Bicyclic heteroaromatics | | 2 | | |
| **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 | |  | | |

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|  | **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 | |  | | |
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| **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:**   * 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 | | 5 | | |
| **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 | |  | | |

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|  | **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. | |  | | |
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| **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/ Action potential in cardiac muscle. Cardiac cycle,ECG, (P-QRS-T) | | 10 | | |
| **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. | |  | | |

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|  | **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 | | |  | | |
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| **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 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). | | 5 | | |
| **7** | | Instrumentation of UV visible spectrophotometer, single beam UV visible spectrophotometer and double beam spectrophotometer, Woodward fisher Rule | | 5 | | |
| **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 | | 5 | | |
| **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 | | |
| **List of Text Books/ Reference Books** | | | | | | |
|  | | Beckett, A.H & Stenlake, J.B, Practical pharmaceutical chemistry, 4thEdn. (Part II), CBS  Publishers & Distributors, India, 1988. | |  | | |
|  | | Lee D.C & Webb M.L, Pharmaceutical analysis, Wiley-Blackwell, 2009. | |  | | |
|  | | Christian, G.D, Analytical chemistry, 6thedition, John Wiley & Sons. New York, 2003. | |  | | |
|  | | Mendham, J., Denney R.C., Barnes J. D. and Thomas M.J.K., Vogel’s Textbook of quantitative chemical analysis, 6thedn, Prentice Hall, 2000. | |  | | |
|  | | Svehla, G, Vogel’s qualitative inorganic analysis, 7th edition, Prentice Hall, 1996. | |  | | |
|  | | Pavia D.L., Gary M.L., George S.K. and James. A.V.,Introduction to Spectroscopy, Wadsworth Publishing Co Inc; 4thedition, 2008 | |  | | |
|  | | Skoog and West, Principlesof Instrumental Analysis, 4thedition, Saunders College Publishing,USA, 1992. | |  | | |
|  | | WillardH.H.L. L. Merrit & John A., Instrumental Method of Analysis, 6thedition,CBS Publishers & Distributors, New Delhi, 1986. | |  | | |
|  | | William Kemp, Organic Spectroscopy, 3rdedition, Reprinted, Palgrave Publishers Ltd., New York, 2005 | |  | | |
|  | | Indian Pharmacopoeia | |  | | |
|  | | British pharmacopoeia | |  | | |
|  | | 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. | | | | |

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|  | **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** | | | 1 | | |
|  | | 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 | | | 4  4 | | |
|  | | 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 | | | 4  4 | | |
|  | | 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 | | | 4  4 | | |
|  | | 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 | | | 3 | | |
| **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. | | |  | | |

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|  | **Course Code:** HUT1102 | | **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 –   1. Origin and definition of sociology; nature of sociology as a science 2. Scope of sociology and its relevance to the industry ( specifically, pharma) 3. Basic concepts in Sociology – society, social structure, social groups and social institutions 4. Social groups and Culture 5. Determinants of Social Development & social change: Individual Personality, social behavior, socio-cultural development | | | 6 | | |
| **2.** | | Applications & relevance of Sociology –   1. Sociology as a profession – policy, planning, teaching, research 2. Career opportunities in Sociology – Social work, NGO, Media, Social Welfare organisations, Labour welfare, Criminology, Jornalism, Industry (CSR/HRD/HRM) 3. 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, 4. Meaning, definition and factors of social change – cultural, technological, geographic, demographic factors leading to diversity or cultural lag, Unity in diversity 5. Barriers in communication reduced or minimised, definition and levels of communication, improving communication in organization | | | 8 | | |
| **3.** | | Organisation of work in Industry ( specially Pharma)   1. 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 2. Management- Employee relations - Human Resource Management, Collective Bargaining, Trade Unions 3. Liberalisation, Privatisation, Globalisation - impact on pharma industry 4. 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 –   1. Definiton of ethics, nature and scope of human values and ethics, Meaning of ethics 2. Importance of ethics & moral standards, its relevance in social and professional life 3. Great Personalities who are role models | | | 4 | | |
| **2.** | | Ethical concepts:   1. Concept of ‘Right & Wrong’ ; ‘Good & Bad’; Difference between the two 2. Concepts of Virtue and vice, Justice and fairness 3. Individual, Society, Social groups, Institutions, Industry and Ethical norms – their relevance and relation   (all these concepts to be discussed through case studies) | | | 5 | | |
| **3.** | | Practical ethics – **sociology perspective**   1. Social ethics – ethics in business communication in a global market, legal aspects in communication and business observed and followed, 2. Business ethics including moral and social responsibility of business organizations 3. Consumer Behaviour and Society: Consumer rights, ethical advertising, consumer education, consumerism 4. Ethics and values in R&D – Understanding critical importance of R&D, Plagiarism and legal remedies 5. 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** | | |  | | |
|  | | Understand and appreciate the value of ethical behaviour | | |  | | |
|  | | Explain ethical concepts through contrasting ideas | | |  | | |
|  | | Relate to ethics in society, business and professional life | | |  | | |

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|  | **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 | |  | | |
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| **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 | |  | | |

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|  | **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 | |  | | |

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|  | | **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** | | | | | | | | |
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| **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 Willstatters Method DNS Method  Folin- Wu Method (Blood Sugar) | | | | 8 | | |
| **3** | | Qualitative tests for Amino acids, Proteins and Precipitation of proteins | | | | 8 | | |
| **4** | | Quantitative tests 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, KM, VMax. | | | | 8 | | |
| **6** | | Vitamins; Quantitative determination of Vitamin C | | | | 4 | | |
| **7** | | Lipids; Determination of acid value and iodine value of lipids. | | | | 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**

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|  | **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 2ndedition, 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 | |  | | |

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|  | **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. | | |  | | |

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|  | **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) | | 5 | | |
| **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. | | | | |

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|  | **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 | | 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(1H 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** | | Structuralelucidationofsimpleorganiccompounds using:1HNMR 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 | | 5 | | |
| **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 | | |
| **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 | | | | |

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|  | **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 | |  | | | |

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|  | **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** | 1. Principles of qualitative separation of organic mixtures using physical properties, chemical properties and their combination 2. Principles of quantitative separation of organic mixtures using physical properties, chemical properties and their combination | | 4  ~~4~~ | | |
| **2** | 1. Separation of solid-solid water insoluble binary organic mixtures 2. Separation of solid-solid partly water soluble binary organic mixtures 3. Separation of solid-solid mixtures by fractional crystallization 4. Separation of liquid-liquid mixtures by distillation 5. 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 | |  | | |

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

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|  | **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 (Alkali earth metal determinations), DSC,TGA Demonstration | | 4 | | |
| **2** | NMR, Mass Spectroscopy, GCMS Demonstration | | 4 | | |
| **3** | NMR, Mass Spectroscopy problem solving from recorded spectra | | 4 | | |
| **4** | Absorption spectroscopy (UV, Visible); | | 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** | | | | | |
|  | Indian Pharmacopoeia | |  | | |
|  | United States pharmacopoeia | |  | | |
|  | 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 | | | | |

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|  | **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**

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|  | **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. | | 5 | | |
|  | 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:** H1antagonists- Classical antagonists & Non-sedative H1antagonists | | 2 | | |
| **9** | **Antiulcer agents:** H2 antagonists, Proton Pump inhibitors etc | | 3 | | |
| **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. | |  | | |

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|  | **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, 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 | | 5 | | |
| **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 1stedition, Vallabh Prakashan, 1955 | |  | | |
| 2 | Robert E. Notari, Biopharmaceutics &Clinical Pharmacokinetics-An Introduction 4thedition, Marcel Dekker Inc, 1971 | |  | | |
| 3 | Malcolm Rowland Thomas N. Tozer, Clinical Pharmcokinetics- Concepts & Applications 2ndedition, Lea & Febiger,Philadelphia, 1989 | |  | | |
| 4 | Milo Gibaldi, Biopharmaceutics &Clinical Pharmacokinetics 3rdedition, 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. | |  | | |

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|  | **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** | | | | | |
|  | - | |  | | |
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| **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, 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 care cosmetics | | 6 | | |
| **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 | |  | | |

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|  | | | **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. | | | | | | | | |

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|  | **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 | | |  | | |

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|  | **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, 3rd edition 2009 | |  | | |
| 9 | M Burande, Principles and Practice of Drug Store Administration Nirali Prakashan, 10th edition 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 | |  | | |

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|  | **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 | |  | | |

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|  | **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 | |  | | |

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|  | **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**

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|  | **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 agonist/antagonist analgesics, µ-antagonists, Antidiarrheal agents, Cough suppressants, anti-tussives narcotic and others. | | 5 | | |
| **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 | |  | | |

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|  | **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. * Preformulation considerations for tablet coating * Types of coating * Sugar coating: Advantages, excipients in coating, methods, equipments, advances in coating equipments, problems in coating and solutions thereof * 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 | | 5 | | |
| **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:   + Extraction of gelatin by acid and alkali treatment, advances in gelatin extraction, quality control tests   + 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. | |  | | |

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|  | | **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. | | | | | |  | |

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|  | **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 | | 2 | | |
| **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.,) | | 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 | | 2 | | |
| **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 | |  | | |

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|  | **Course Code:**PHP1115 | **Pharmaceutics/ 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 | |  | | |

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|  | **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 | | | | PA2 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 PA2 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. | | |  | | | |

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|  | **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. No.** | **Course contents (Topics and subtopics)** | | **Reqd.hours** | | |
| **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. | |  | | |

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|  | **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** | | | | | | | | |
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| **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**

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|  | **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:**   1. **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   1. Antigens, antibiotics, diagnostic kits 2. 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 | |  | | |

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|  | **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), 22ndedition, 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. | |  | | |

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|  | **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 | | | | | |

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| **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. |  |

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|  | **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 | |  | | |
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| **Description of relevance of this course in B-Pharm Program** | | | | | |
| To train the students with the basics of pharmacognosy and phytochemistry | | | | | |
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| **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. | |  | | |

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|  | **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** | 1. Fundamentals of Management: Meaning of management, functions of management, importance of management, difference between management and administration; 2. 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** | 1. Organizations – Formal and Informal; Types of organizational structures; 2. Delegation of Authority and Decentralisation; Advantages and Disadvantages 3. Controlling systems and process of control. Control techniques: human resource and technological: both qualitative and quantitative 4. Techniques of communication, direction, participation, delegation, decision making, control tools (PERT, CPM), systems, policies, procedures, methods to operate organization 5. 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 –   1. Definition, need and importance, traits of a leader, leadership styles, Types of Leaders and leadership, Role models from Industry 2. Trait theory, Behavioural theory, Managerial Grid, Contingency Theory, Situational Theory, Path-Goal Theory 3. Transactional Analysis and Gestalt Theory | | 5 | | |
| **4** | Motivation – needs, wants and processes.   1. Maslow’s hierarchy of human needs 2. Herzberg’s two-factor theory of motivation 3. Vroom’s theory of Expectancy 4. Understanding business forecasting, market demand and sales strategy with conflict resolution, creativity and innovation, delegation and decision making. | | 3 | | |
| **5** | Managerial Economics & Product management -   1. Nature and scope of managerial economics; Demand theory and analysis; Determinants of demand – price, income, quality, market, competition, market elasticity 2. Theory of Consumer choice: The Cardinal Utility Approach; Indifference Curve Approach; Revealed Preference and the theory of Consumer choice under risk 3. Production theory and estimation. The Cost theory and estimation. The short and long run cost functions. Theories of Cost. 4. Time Management vis a vis Product Development, Software Development and Implementation, Market surveys, 5. 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 –   1. Concept, definition, nature of marketing, marketing tasks, and marketing management philosophies 2. Marketing Information Systems & Market research 3. Pharmaceutical Market – buyer and consumer behaviour 4. Marketing Pillars –product and market segmentation, targeting, positioning, advertising and sales promotion, retail management, market measurement and forecasting 5. Pricing decisions - Pricing methods & strategies, Branding, packaging and labeling | | 5 | | |
| **7** | Sales forecasting -   1. Budgeting, budgetary planning and controls 2. Operations management, developing and managing products : old and new 3. Production planning & control systems; 4. Materials management systems; Inventory schedule, planning and management 5. Sales promotion, trade shows, exhibitions, sales meetings, sales training manuals , | | 6 | | |
| **8** | Supply chain management –   1. Scope of supply chain management in pharma sector 2. Drivers and obstacles of supply chain 3. Identification of vendors, pricing, negotiation 4. Management of inventories - Procurement of raw materials and packing materials 5. Transportation and despatch planning 6. Logistic management in supply chain 7. Financial factors significant for supply chain 8. Role of information technology in supply chain | | 7 | | |
| **9** | Money management –   1. Labour laws 2. 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. | |  | | |

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|  | **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 | |  | | |
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| **List of Courses where this course will be prerequisite** | | | | | |
|  | Pharmaceutics-VI | |  | | |
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| **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 protoype | | 4 | | |
| **5** | Representative examples of ophthalmic formulations (Preparation, packaging and evaluation) | | 12 | | |
| **6** | Representative examples of contact lens solution (Preparation, packaging and evaluation) | | 4 | | |
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| **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 | |  | | |

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|  | **Course Code:** PHP1206 | | | **Course Title: – Pharmacology Laboratory-II** | | **Credits = 2** | | |
| **L** | **T** | **P** |
| **Semester: VI** | | | **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. | | | | | | | |

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|  | **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 | |  | | |
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| **Description of relevance of this course in B-Pharm Program** | | | | | |
| To train the students with the basics of pharmacognosy and phytochemistry | | | | | |
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| **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. | |  | | |

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|  | **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**

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|  | **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:**   1. Nomenclature and 3-D structure of steroids, Biosynthesis and metabolismof steroids. 2. Corticosteroids – Glucocorticoids- systemic topical and inhaled, Mineralocorticoids. 3. 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, 6thedition, 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, 2ndedition, 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 | |  | | |
|  | **Note:** The above course outcomes are related to Steroidal Drugs, Thyroid Drugs, vitamins | |  | | |

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|  | **Course Code:** PHT 1213 | | **Course Title: Clinical Pharmacy and Drug Interactions** | **Credits = 3** | | | |
| **L** | | **T** | **P** |
| **Semester: VIII** | | **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. | | |  | | |

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|  | **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. | |  | | |

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|  | **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** | | | | | | | |
|  | 10th std. Biology; 12thstd 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, 2nd 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 | | |  | | |

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|  | **Course Code:** PHP1404 | **Course Title: Medicinal 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** | | | | | |
|  | - | |  | | |
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| **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 | |  | | |

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|  | **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 system | | 20 | | |
| **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 | |  | | |

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|  | **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. | |  | | | |

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|  | **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**

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|  | **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 | |  | | |

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|  | **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 | |  | | |

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|  | **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 | |  | | |

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|  | **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 | |  | | | |

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|  | **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:**  AES, XPS, AFM, Contact Angle | | | 2 | | |
| **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 | | |  | | |

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|  | **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** | | | | | |
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| **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): | |  | | |
| 1. Anti-infective (2 molecules) | | 2 | | |
| 1. CNS drugs (2 molecules) | | 2 | | |
| 1. CVS drugs (2 molecules) | | 2 | | |
| 1. Anti-diabetic drugs (2 molecules) | | 2 | | |
| 1. Anti-histaminics (2 molecules) | | 2 | | |
| 1. Anticancer compounds (2 molecules) | | 2 | | |
| 1. NSAIDS (2 molecules) | | 2 | | |
| 1. 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 | |  | | |

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|  | **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 | |  | | |
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| **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 | |  | | |

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|  | **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** | | | | | |
|  |  | |  | | |
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| **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** | 13C-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 | |  | | |