

**Chitkara University
Academic Program Guide**

Bachelor of Pharmacy

(For Session 2011 Onwards)

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1. General Information

The academic program Guide is a comprehensive document detailing course scheme, associated credits per course and the distribution of each course in lecture, tutorial and Practical hours. It also details the eligibility criteria for admission, for award of degree, the assessment and evaluation procedures along with a glimpse of the pedagogical aspects of the programs. This Guide is to be used in association with the Academic Regulations of the University to make a complete rule set. The course schemes given in this document are approved by respective Board of Studies and the Academic Council of Chitkara University. The Course code gives information about the course and is derived using Table in Appendix A.

1.1 Programme Overview:

Pharmacy as academic discipline makes for an enriching learning experience as it perfectly combines technology and health care system. The profession of pharmacy has transformed into a hub for the "Global Healthcare" and evolved as a multidisciplinary, multifaceted curriculum. Learning and working in harmony with other members of health care are the immediate needs for the ideal role and social relevance of pharmacist in the health care system of our country. So, the academic system at CCP has been framed taking into consideration the responsibility of undergraduate students to meet the demands of hi tech pharmaceutical industry, at the same time ensuring that they confidently serve the requirements of patient care and pharmacy practice. Conscious efforts to inculcate research aptitude in its students through elective research projects to keep them abreast of the requirements of the industry.

Program Objectives: Some of the main objectives of our Pharmaceutical programs are:

1. To provide exemplary education in a stimulating environment where delivery of superb pharmaceutical knowledge is integrated with nationally and internationally recognized research data to enable students to conduct and publish cutting-edge multidisciplinary research in the discovery, utilization and evaluation of therapeutic agents.
2. To prepare competent pharmacists at various levels for India.
3. To prepare globally capable pharmaceutical scientists.
4. To become efficient leaders in various stages of pharmaceutical production, marketing and distribution.

1.2 Placement Opportunities:

The Bachelor program in Pharmacy provides ample opportunity to a graduate to join various areas in Pharmaceutical industry set up as well as in a hospital pharmacy support. The level of appointment and compensation there upon may depend upon the job profile and need for further additional post graduate specialization in specific areas. The possible positions are:

- a. Research & Formulation Development Executive: Development of new formulations
- b. Production Executive: Managing and supervising production of formulations
- c. Project Executive (New Products): Coordinating the research, production and marketing activities in a Pharmaceutical organization, deciding as to what and how to develop a new product and plan production and marketing activity as per available capacity.
- d. Project Executive (New Plant): coordinating & erection, installation commissioning of production in a new plant / facility and ensuring that all installation and procedures are as per compliance norms laid out by regulatory agencies.
- e. Executive (Administration & Finance)/ management Trainee: in a pharmaceutical organization.
- f. Executive /Asth Manager, Regulatory affairs: Helping the research team to compile drug master files for new drug products for registration and approval with the food & Drug authority of different countries.
- g. Hospital Pharmacist: He may further diversify into Clinical Pharmacist and then specialize into Geriatric, Paediatric or other specific area in a govt or private setup in India or in other countries including USA, UK, UAE and others.
- h. Sales and Marketing: He may take up a career in marketing starting as a sales person and then diversifying into Product Management, training and market research.

2. Eligibility for Admission

The student seeking admission in B. pharm. program should have minimum 50% marks in 12th grade or equivalent exam as declared by CBSE or equivalent examining authorities, with Mathematics/Biology and Physics and Chemistry as compulsory subjects. The admission is based purely on merit.

During admission process, the University follows reservation policy as decided by the State.

3. Duration and Stages

The duration of the B Pharm. program is four years - divided into 8 semesters. There is University end term examination at the end of each semester.

The maximum duration of completion of degree is 6 years.

4. Rules for attendance

As detailed in Academic Regulations section 6, a minimum attendance of 75% is compulsory for the student to be eligible to appear for end semester examination. 10% concession in this mandatory requirement is possible only in extreme circumstances and at the sole discretion of the Vice Chancellor.

There is no weightage for attendance in evaluation criteria.

Students are encouraged to participate in co-curricular activities conducted by prestigious institutions at national/International level. Such students would be eligible for grant of special Duty Leaves (limited by a cap decided by the Vice Chancellor) to make up for the attendance, in case any class work is missed during this period. This privilege extended to students will not be termed as right and is limited to just the attendance benefit.

5. Special Courses

Research Project: In the VII and VIII semester of B. Pharm course, the students work on a unique integrated project allotted to them by an allotted project guide. The project is aimed at carrying out extensive review and summarization on the work done in the area in the past and propose a new possible dimension and method to carry out research and then actually carry out their research work and present as research report. The evaluation is as per academic program guide for these. The projects may also be allotted to them in other semesters either at the start of each semester or at a later stage (but not later than Sessional test I) in the semester, depending on the interest of students but are not evaluated by the usual grade but by letter grades. All projects are designed by the faculty keeping in mind the courses the students have studied so far and are currently studying. Thus, the project statements are made such a way that the students while working on these projects apply the concepts learned so far and the deliverables are multi-faceted. The students work on the Integrated Project during their lab hours.

Industry Oriented skills are imparted to students in three types of courses:

IOHT (Industry Oriented Hands-on Training)

IOHC (Industry Oriented Hands – on Courses)

Project work at Industry

IOHT are very basic and low level industry skills which are essential for the students to build up their engineering profession on. The IOHT is placed after or during III year of graduate level degree. It has to be a minimum of 4 weeks training to be pursued in vacation period.

Industry Oriented Hands-on Courses (IOHCs) are short term skill oriented courses and are more often than not, offered in association with an industry. They aim to train the students in a specific skill / platform/ tool/ technology which are state-of-art. It fills the gap between present curricula and the specific industry needs. It also circumvents the problem of revising the curricula time and again, to align it to current industry requirements. The short duration IOHCs (2-5 days) can be offered during the academic semester and long duration IOHCs (4-6weeks) are offered as summer courses. Summer IOHCs can be taken up at the campus or at the Industry. The IOHC may result in certification by Industry in a specific skill set. HOD in consultation with Dean of the School has the authority to offer and assign IOHCs, as the case may be, for appropriate semesters or during summer, at various industries or at the campus. The students are may be given freedom to choose his/her own IOHC, but the decision of HOD is final while allotment.

In special cases, a student may take up a parallel project with a Pharma industry during vacations and submit a report for evaluation. For the same he may be allotted a faculty as a guide.

If a student disregards the allotment of any IOHT/IOHC, he/she may forfeit the IOH option entirely. The consequence of such an action could be that the concerned student may have to wait for the next academic year to get an opportunity to pursue IOHT/IOHC/IOHE, after paying the appropriate fee.



6. Pedagogical Aspects

The structural layout of the program and its courses requires that each course be divided in lecture, tutorial and practical sessions. Duration of each session as given in the column against the course in the course scheme is 60 minutes.

Lecture sessions: Lectures are delivered by traditional - chalk board method, supplemented by modern Information Communication technology (ICT) methods. The students are encouraged to ask questions and involve in group discussion to the extent allowed by the teacher. In some subjects where case study based methodology is adopted, the lectures are supplemented by discussions on case studies.

Tutorial Sessions: The tutorial sessions are small groups of students interacting with the teacher, solving application oriented analytical problems. The tutorial sessions are very interactive and inculcate problem solving skills in the students.

Lab / Practical Sessions: During lab / practical sessions, the students work on prescribed list of experiments and do what they have learnt in the Lecture / Tutorial sessions.

7. Assessment and Evaluation

The evaluation will be continuous and the weightage of various components are as given in Table 1 (For Theory courses) and in Table 2 (for Practical Courses).

Table 1: Evaluation components for Theory Courses

For Theory Courses	
Assignment/Quiz/ Seminar	5
Sessional Tests (STs)	15
End Term Examination	80
Total	100

There are three Sessional Tests (STs) for all theory papers, the average of best two are considered. The policy on the evaluation component – ‘Quizzes / Tutorials / Assignments’ is decided by the course coordinator and HoD and is announced separately for each course. The End Term examination for practical courses includes conduct of experiment and an oral examination (viva voce)

Table 2: Evaluation Components for Practical Courses

For Lab Courses	
Lab Performance / File work	10
Internal Viva – Voce	10
End Term	80
Total	100

Table 3: Evaluation Components for Integrated Project

For Integrated Projects	
Performance / Presentation / Project report	10
Internal Viva – Voce	10
End Term – Project viva voce	80
Total	100

***Students are required to obtain 40% marks both in internal and external examination separately**

The medium of examination is English.

Criteria to Pass Examination: Based on the marks obtained by the student in a particular course as described in tables above, the grade in that course is obtained, in accordance with the table 4

Table 4: Grading scheme

% Marks Range of total	Grade	Qualitative meaning	Grade point
90 - 100	A+	Distinguished	10
85 - 89	A	Excellent	9
80 - 84	A-		8.5
75 - 79	B+	Very Good	8
70 - 74	B		7.5
65 - 69	B-	Good	7
60 - 64	C+		6.5
55 - 59	C	Fair	6
50 - 54	C-		5.5
45 - 49	D+	Satisfactory	5
40 - 44	D		4.5
0 - 39	E	Exposed	0
	I	Incomplete	

Students are required to obtain 40% marks both in internal and external examination separately

If a student obtains grade D or above, he is declared pass in that subject.

A student shall be eligible to carry forward all the courses of I, II and III semesters till the IV semester examinations. However, he/she shall not be eligible to attend the courses of V semester until 50% of internal and external examination of total number of Theory and Practical subjects of I and II semesters are successfully completed.

If the student is detained from appearing in the end term examination because of shortage of attendance in the regular semester or is absent in the end term exam, his grade in that subject is 'I', till he/she appears again in the end term examination and obtains a new grade.

In special medical cases the academic committee of the Chitkara University, Punjab may consider further promotion after appropriate examination and review.

8. Eligibility for award of degree

In addition to conditions given in section 8 of Academic Regulations, a CGPA of 4.5 is required to receive degree. The minimum credits to be earned are given in table 5.

Table 5: Minimum credits to be earned for award of degree in Pharm.

Course / Year	B. Pharm.
Year I	58
Year II	53
Year III	56
Year IV	56
Total	223

9. Course Scheme

Semester I			
Course Code	Title of the Course	Hours (L+T+P)	Credit
PHL 4101	General Pharmacy	4+0+0 = 4	4
PHL 3103	Pharmaceutical Analysis-I	3+0+0 = 3	3
CLL 4104	Technical English	4+0+0 = 4	4
PHL 3105	Pharm Chemistry-I (Inorganic Pharm Chemistry)	3+0+0 = 3	3
CAL 4109	Computer Science and Applications	4+0+0 = 4	4
PHL 3107	Pharmacognosy-I	3+0+0 = 3	3
PHP 2103	Pharmaceutical Analysis-I	0+0+4 =4	2
PHP 2105	Pharm Chemistry-I (Inorganic Pharm Chemistry)	0+0+4 =4	2
CAP 2109	Computer Science and Applications	0+0+4 =4	2
PHP 2107	Pharmacognosy-I	0+0+4 =4	2
	Total	37	29

Semester II			
Course Code	Title of the Course	Hours (L+T+P)	Credit
PHL 4102	Pharmaceutics –I (Dispensing and Community Pharmacy)	4+0+0 = 4	4
PHL 4104	Pharmacognosy-II	4+0+0 = 4	4
PHL 4106	Pharmaceutical chemistry-II (Physical Chemistry)	4+0+0 = 4	4
PHL 4108	Pharmaceutical chemistry-III (Organic chemistry-I)	4+0+0 = 4	4
PHL 3110	Anatomy Physiology and Health Education –I	3+0+0 = 3	3
PHP 2102	Pharmaceutics –I (Dispensing and Community Pharmacy)	0+0+4 =4	2
PHP 2104	Pharmacognosy-II	0+0+4 =4	2
PHP 2106	Pharmaceutical chemistry-II (Physical Chemistry)	0+0+4 =4	2
PHP 2108	Pharmaceutical chemistry-III (Organic chemistry-I)	0+0+4 =4	2
PHP 2110	Anatomy Physiology and Health Education –I	0+0+4 =4	2
	Total	39	29

Total credit of Ist yr Courses: 29+29=58

B. Pharmacy Ist Semester**PHL 4101 General Pharmacy (4-0-0) 4 Credit**

Orientation and Historical Background of pharmacy profession, Pharmacy as a career, Pharmacy Profession: History of Pharmacy in India, Pharmaceutical education in India and abroad. Official books, Routes of drug administration, Introduction to different dosage forms: Definitions of solid dosages form like powders and granules, dentifrices, capsules and tablets, liquid orals like solutions, aromatic waters, syrups, spirits, elixirs, glycerin, lotions, liniments, gargles, mouth washes, douches, draught preparation, sterile products like injectable, implants, ophthalmic formulations and semi-solid products, solutions for external use- suppositories, Additive of dosage forms: preservatives, antioxidants, surfactants, hydrocolloids, Diluents, binders, lubricants, organoleptic additives, Crude extracts and extractives important terminologies in Pharmacy, Pharmaceutical Waters and their Processing

Books Recommended:

1. Remington, the Science and Practice of Pharmacy, Current Edition, Mack Publishing Co., U.S.A.
2. J.W. Cooper and G. Gunn, Tutorial Pharmacy, Current Edition, Pitman Books Ltd., London, U.K.
3. S.J. Carter, Dispensing for Pharmaceutical Students, Current Edition, Pitman, Books Ltd., London, U.K.
4. G.S. Banker and C.T. Rhodes, Modern Pharmaceutics, Current Edition, Marcel Dekker, New York, USA.
5. C. Raymond, J.P. Rowe, and E.M. Sheskey, Handbook of Pharmaceutical Excipients, Current Edition, Pharmaceutical Press, London, U.K.
6. Allen, Loyd V. and Ansel, H.S., Pharmaceutical Dosage Forms and Drug Delivery, 9th Edition.

PHL 3103 Pharmaceutical Analysis-I (3-0-0) Credit 3**PHP 2103 Pharmaceutical Analysis-I (0-0-4) Credit 2**

Quantitative Analysis and Data Handling, Acid Base Titrations: Acid base concept, role of the solvent, Law of mass action, Handerson – Hasselbach equation; Buffer and buffer capacity: Acid base indicators, Neutralization curves. Oxidation-Reduction Titrations: Concepts of oxidation and reduction, redox reactions, electrochemical cells, Nernst equation, oxidation reduction curves, potassium permanganate titrations, iodimetry and iodometry, ceric sulphate titrations, potassium iodate titrations, sodium 2, 6- dichlorophenol - indophenol titrations, pharmaceutical applications. Precipitation Titrations: Precipitation reactions, solubility product, argentimetric titrations, ammonium or potassium thiocyanate titrations, mercuric nitrate titrations, indicators, Gay-Lussac method, Mohr's method, Volhard's method, Fajan's method. Gravimetric Analysis: Precipitation techniques, thermogravimetric curves of copper sulphate, specific examples like barium as barium sulphate, aluminium as aluminium oxide, calcium as calcium oxalate and magnesium as magnesium pyrophosphate, organic precipitants.

Lab: Standardization of analytical weights and calibration of volumetric apparatus., Preparation and standardization of acids and bases; some exercises related with determination of acids and bases separately or in mixture form, some official assay procedures e.g. boric acid should also be covered., Preparation and standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate, etc. Some exercises related to determination of oxidizing and reducing agents in the sample shall be covered. Exercises involving potassium iodate, potassium bromate, iodine solution, titanous chloride, sodium 2, 6- dichlorophenol indophenol, and ceric ammonium sulphate., Preparation and standardization of titrants like silver nitrate and, ammonium thiocyanate, Titrations according to Mohr's, Volhard's and Fajan's method, Preparation of gooch crucible for filtration and use of sintered glass crucible, Determination of water of hydration, Some exercises related to gravimetric analysis should be covered.

Books Recommended:

1. Becket & Stenlake. Practical Pharmaceutical Chemistry. Current edition, CBS Publishers, New Delhi.
2. Jeffery, Bassett & Mendham. Vogel's text book of Quantitative chemical analysis. Current edition. Addison Wesley Longman Ltd. England.
3. Alexeyev, Qualitative Analysis. Current Edition. CBS Publishers, New Delhi.
4. L. M. Atherden, Bentley and Driver's Textbook of Pharmaceutical Chemistry, current edition. Oxford University Press, Delhi.

CLL 4104 Technical English (4-0-0) Credit 4

Orientation to the Course and Ice Breaker ,Activity- Parts of speech + Refresher on types of sentences PPT- Common Errors in English,Speaking Activity- Open House Discussion,Reading comprehension- Introduction and Practice ,Speaking Activity- Concocting stories + Verbal Ability Worksheet (Synonyms & Antonyms) ,PPT- Functional English (Focusing on Subject Verb Agreement),Free Writing, Speaking Activity- JAM + Verbal Ability Worksheet (British & American Vocabulary),Business Letters- Format & Practice (Sales; Claim; Adjustment; Cover Letter), Business Letters- Practice-Contd, Speaking Activity- Flip + Verbal Ability Worksheet (One word substitution), PPT- Functional English (Focusing on Tenses), Memos-Format,Memos- Practice,Direct and Indirect Speech,Writing for advertisements,Speaking Activity- Extempore + Verbal Ability Worksheet (Idioms),Business Emails- Format & Assignment,Proposals (Letter; Email or Memo) with practice writing,Active and Passive Voice,Speaking Activity- Roleplays,Report Writing & Assignment,Speaking Activity- Debate

Books Recommended:

1. Meenakshi Raman and Sangeetha Sharma, "Technical Communication: Principles and Practice", Oxford University Press, New Delhi, 2004.
2. Andrea J. Rutherford, "Basic Communication Skills for Technology", Pearson Education Asia (Singapore) Pvt. Ltd., Bangalore, 2001.
3. Ashraf Rizvi, "Effective Technical Communication", Tata McGraw-Hill, New Delhi, 2005.
4. Ramakrishna Rao, "Learning English: A communicative Approach", Orient Longman, Hyderabad, 2006.
5. William Sanborn Pfeiffer and T.V.S. Padmaja, "Technical Communication: A Practical Approach", Sixth Edition, Pearson Education, 2007

PHL 3105 Pharmaceutical Chemistry-I (Inorganic Pharmaceutical Chemistry-I) (3-0-0) Credit 3

PHP 2105 Pharmaceutical Chemistry-I (Inorganic Pharmaceutical Chemistry) (0-0-4) Credit 2

Impurities , limit test for chlorides, sulphates, iron, lead and arsenic, Major Intra & Extracellular Electrolytes, Major Physiological ions (Chloride, Phosphate, Bicarbonate, Sodium, Potassium, Calcium, Magnesium); Electrolytes used in replacement therapy (Sodium chloride), Potassium replacement (potassium chloride), Calcium replacement (Calcium chloride, Calcium gluconate) Parenteral magnesium administration (Magnesium sulphate), Physiological acid base balance, Electrolytes used in acid base therapy (Sodium acetate, Potassium acetate, Sodium bicarbonate, Sodium citrate, Potassium citrate, Sodium lactate, Ammonium chloride), Electrolyte combination therapy, Essential and Trace Element; Iron, Copper, Zinc, Chromium, Manganese, Molybdenum, Selenium, Sulphur and Iodine. Official Iodine Products (Iodine, Potassium iodide, Sodium iodide). Gastrointestinal Agents: Acidifying agents , Protectives and Adsorbents , Saline Cathartic, Topical Agents: Antimicrobials and Astringents, Oxidative Antimicrobial Agents, Protein Precipitant Antimicrobial Agents: Co-ordination Compounds and Complexation, Miscellaneous Inorganic Pharmaceutical Agents: Inhalants, respiratory stimulants, expectorants and emetics, antidotes, tableting aids and suspending agents.

LAB: Limit tests for impurities in pharmacopoeial compounds, Quantitative analysis-assay of the following compounds: Boric acid, Solution of ammonia, sodium bicarbonate, sodium chloride, calcium hydroxide, The background and systemic qualitative analysis of inorganic mixtures up to 4 radicals. Six mixtures to be analyzed, preferably by semi-micro methods, to carry out identification tests for calamine, boric acid, hydrogen peroxide.

Books Recommended:

1. "Vogel's Textbook of Quantitative Inorganic Analysis", ELBS/ Longman, London.
2. J. H. Block, E. Roche, T. O. Soine and C. O. Wilson, "Inorganic Medicinal and Pharmaceutical Chemistry", Lea and Febiger, Philadelphia PA.
3. S.N.Pandeya: A Textbook of Inorganic Medicinal Chemistry, Current Edition, S.G.Publishers, Varanasi.
4. L.M.Atherdon, Benly and Drivers: Textbook of Pharmaceutical Chemistry,Current edition, Oxford University Press, Delhi.
5. "Pharmacopoeia of India", Govt. of India, Ministry of Health.

CAL 4109 Computer Science and Applications (4-0-0) Credit 4

CAP 2109 Computer Science and Application (0-0-4) Credit 2

Computer Fundamentals, Operating Systems, Communication Networks, Computer Programming, Simple programming using 'C' Data types, Computer Applications, Word processing: Techniques, Spreadsheet package , Graphics, Data security against viruses, Pharmaceutical applications, Basics of computer use in various pharmaceutical and clinical

applications like drug information services, hospital and community pharmacy, drug design, pharmacokinetics and data analysis.

LAB: Computer operating systems like MS-DOS, MS-Windows, Word-processing like MS-Word, Spreadsheet calculations using MS- Excel, Graphic applications using MS-Power Point, MS-Excel, Programming using 'C'.Book references .

Books Recommended:

1. Fundamentals of Computers by Rajaraman, Prentice Hall of India
2. Tiwari, NK, Computer Fundamental with Pharmacy Applications, Current edition, Pharm Med Press
3. Learn MS-Office 2000 by Stultz, BPB Publications.
4. Using Microsoft Windows 1998 by Ivens, Prentice Hall of India.
5. Learn DOS in a day by Stultz, BPB Publications.
6. Introduction to Computers by Sinha, P K, BPB Publications

PHL 3107 Pharmacognosy –I (3-0-0) Credit 3

PHP 2107 Pharmacognosy –I (0-0-4) Credit 2

Definition, history, scope and development of Pharmacognosy, Sources of drugs, Classification of drugs, Plant taxonomy: Apocynaceae, Solanaceae, Rutaceae, Umbelliferae, Leguminosae, Rubiaceae, Liliaceae, Graminae, Libiatae, Cruciferae, Papaveraceae. Cultivation, collection, processing and storage of crude drugs, Quality control of crude drugs. introduction to active constituents of drugs. Systematic Pharmacognostic study of following: a) Carbohydrates and derived products: Agar, Guar gum, Acacia, Honey, Isabgol, Pectin, Starch, Sterculia and Tragacanth. b) Lipids: Bees wax, Castor oil, Cocoa butter, Cod-liver oil, Hydnocarpus oil, Kokum butter, Lard, Linseed oil, Rice-bran oil, shark liver oil and wool fat.

LAB: Morphological characteristics of plant families mentioned in Theory, Microscopic measurements of cells and cell contents: Starch grains, calcium oxalate crystals and phloem fibres, Determination of leaf constants such as stomatal index, stomatal number, veinislet number, vein-termination number and palisade ratio, Identification of crude drugs belonging to carbohydrates and lipids, Preparation of herbarium sheets.

Books Recommended:

1. W. C. Evans, Trease and Evans Pharmacognosy, Current Edition, W. B. Saunders Limited,
2. G. E. Trease, A Textbook of Pharmacognosy Current Edition, Bailliere Tindall, London.
3. V. E. Tylor, L. R. Brandy & J. E. Robbers, Pharmacognosy, Current Edition, K.M. Varghese Company, Bombay, India.
4. B. P. Jackson & D. W. Snowdon, Powdered Vegetable Drugs, Stanley Thomes Ltd., London,
5. Kokate, C. K., Pharmacognosy, Nirali Publications
6. Kar, Ashutosh, Pharmacognosy & Pharmacobiotechnology, New Age Publications

B. Pharm. Semester- II

PHL 4102 Dispensing and Community Pharmacy (4-0-0) Credit 4

PHP 2102 Dispensing and Community Pharmacy (0-0-4) Credit 2

Definition, Scope and future trends in Dispensing, various part of prescription, Handling of prescription, source of errors in prescription, General dispensing procedures including labelling of dispensing products, Pharmaceutical calculations, Principles involved and procedures adopted in dispensing of mixtures, solutions, emulsions, creams, ointments, powders, capsules, pastes, jellies, suppositories, ophthalmic. Physical, therapeutic and chemical incompatibilities, Community Pharmacy

LAB: Dispensing of prescription falling under the categories: Mixtures, solutions, emulsions, creams, ointments, powders, suppositories, ophthalmic, capsules, paste, jellies, pastilles, lozenges, pills, tablet triturates, lotions, liniments, inhalations, paints, etc. Identification of various types of incompatibilities in prescription, correction thereof and dispensing of such prescriptions. Dispensing procedure involving pharmaceuticals calculations, pricing of prescriptions and dosage calculations for paediatric and geriatric patients. Categorization and storage of Pharmaceutical products based on legal requirements of labeling and storage, Electrolyte solution preparations, Project report on Visit to the nearby Community for Counselling on the rational use of drugs and aspects of Health care.

Books Recommended:

1. Remington, The Science and Practice of Pharmacy, Current Edition, Mack Publishing Co., U.S.A.
2. J.W. Cooper and G.Gunn, Tutorial Pharmacy, Current Edition, Pitman Books Ltd., London, U.K.
3. S.J. Carter, Dispensing for Pharmaceutical Students, Current Edition, Pitman, Books Ltd., London, U.K.
4. G.S. Banker and C.T. Rhodes, Modern Pharmaceutics, Current Edition, Marcel Dekker, New York, USA.

5. C. Raymond, J.P. Rowe, and E.M. Sheskey, Handbook of Pharmaceutical Excipients, Current Edition, Pharmaceutical Press, London, U.K.
6. H.S. Ansel and N.G. Popovich, Pharmaceutical Dosage Forms and Drug Delivery, 9th Edition.

PHL 4104 Pharmacognosy-II (4-0-0) Credit 4**PHP 2104 Pharmacognosy-II (0-0-4) Credit 2**

Study of Drugs Containing Resin and Resin Combination like Colophony, podophyllum, jalap, cannabis, capsicum, myrrh, asafoetida, balsam of tolu, balsam of peru, benzoin, turmeric, ginger, Study of tannins and tannin containing drugs like Gambir, black catechu, gall and myrobalan. General methods of obtaining volatile oils from plants, Study of volatile oils of Mentha, Coriander, Cinnamon, Cassia, Lemon peel, Orange peel, Lemon grass, Citronella, Caraway, Dill, Spearmint, Clove, Fennel, Nutmeg, Eucalyptus, Chenopodium, Cardamom, Valerian, Musk, Palamarosa Gaultheria, Sandal wood. Phytochemical Screening of alkaloids, saponins, cardenolides and bufadienolides, flavonoids and leucoanthocyanidins, tannins & polyphenols, anthraquinones, cynogenetic glycosides, amino acids in plant extracts. Study of fibres used in pharmacy such as cotton, silk, wool, nylon, glass-wool, polyester and asbestos. Study of pharmaceutical aids of category dispersing, emulsifying, suspending agents and viscosity builders, e.g., like talc, diatomite, kaolin, bentonite, gelatin and natural colors.

LAB: Identification of crude drugs mentioned in theory. Identification and standardization methods of fibres and pharmaceutical aids. Microscopic studies of seven-selected crude drugs and their powders mentioned under the category of volatile oils in theory and their chemical test and chromatographic profiles. General chemical tests for alkaloids, glycosides, steroids, flavonoids and tannins.

Books Recommended:

1. Trease, G. E. and Evans, W.C. Pharmacognosy, Published by Elsevier, a Division of Reed Elsevier India Pvt. Ltd., New Delhi.
2. Kokate, C.K., Purohit, A.P. and Gokhale, S.B Pharmacognosy, Nirali Prakashan, Pune.
3. Handa, S.S and Kapoor, V.K. Textbook of Pharmacognosy, Vallabh Prashan, New Delhi.
4. Wallis, T.E. Textbook of Pharmacognosy, Current Edition, CBS Publishers and Distributors, New Delhi.
5. Tyler, V.C., Brady, L.R. and Robers, J.E. Pharmacognosy. Lea & Febiger, Philadelphia.

PHL 4106 Pharmaceutical Chemistry-II (Physical Chemistry) (4-0-0) Credit 4**PHP 2106 Pharmaceutical Chemistry-II (Physical Chemistry) (0-0-4) Credit 2**

Energy and first law of thermodynamics : Preliminary and definitions of systems surrounding macroscopic properties and state variables, thermodynamic equilibria, extensive and intensive properties, first law of thermodynamics, internal energy and first law, enthalpy of system, heat capacity, correlation between C_p and C_v for an ideal gas. Work done on reversible isothermal expansion of an ideal gas, Maximum work, adiabatic expansion of an ideal gas, work of expansion, internal energy change and enthalpy change, Comparison of isothermal and adiabatic changes. Second law of thermodynamics: Limitations of first law and need of second law, cyclic process, Carnot cycle, definition of second law of thermodynamics, spontaneous process, Concept of entropy, entropy change accompanying change of phase, entropy changes in reversible and irreversible processes, Absolute entropy, determination of absolute entropy with the help of third law of thermodynamics, The law of mass action, thermodynamic treatment of the law of mass action and chemical equilibria, expressions for equilibrium constants, relation between K_p , K_c , effect of volume, pressure and temperature.

Solutions : Solutions of liquids in liquids, ideal and real solutions, colligative properties of dilute solution, lowering of vapor pressure of non-volatile solute, osmosis and osmotic pressure in terms of chemical potential, Vant-Hoff equation for osmotic pressure of dilute solutions, elevation of boiling point and depression in freezing point by a non-volatile solute, determination of molar mass from vapor pressure lowering, osmotic pressure, boiling point elevation and freezing point depression, Solute distributing in immiscible solvent, distribution coefficient, conditions for validity of distribution law and the thermodynamic derivation, association and dissociation of solute, biological applications.

Electrochemistry: Electrode potential, Nernst equation, standard potential, standard hydrogen electrode, reference electrodes, indicator electrodes. (a) Potentiometry : Theoretical consideration, ion-selective electrodes, measurement of potential, location of the end point, equipment, analytical applications, differential curves, determination of K_{sp} , pH measurements, dead-stop titrations; pH meter, pH definition, relation of pH to potential, equipment, applications.

(b) Electrolyte Solution : Electrolytes and non-electrolytes, activity and activity coefficients, conductance, molar conductance and its variation with dilution, Debye Huckle theory of strong electrolyte (interionic effect, asymmetry

effect, electrophoretic effect), mean activity coefficient, limiting law equation, conductometric titrations and its applications, high frequency titrations and its applications.

Kinetics: Rate and rate constant, order and molecularity, zero, first and second order reactions, half life time, integration of rate expressions, methods of determining order of a reaction, effect of temperature on reaction rates, Arrhenius equation, Concept of steady state approximation, activation energy, energy barrier. Collision and activated complex theory of bimolecular reactions. Catalysis : Characteristics of catalyzed reactions; definition of the terms, autocatalysis, negative catalysis, inhibitors, promoters, homogeneous and heterogeneous catalysis, acid base catalysis and its mechanism, enzyme catalysis, Michaelis-Menten equation, turn over number, the Line Weaver- Burk method.

Photochemistry: Introduction, consequences of light absorption, the Jablonski diagram, Lambert Beer law, Grotthus Draper law, the Stark-Einstein law of Photochemical equivalence, Quantum efficiency of quantum yield, Photochemical reaction

LAB: To determine molar mass by Rast method and cryoscopic method, To determine refractive index of given liquids and find out the contribution of carbon, hydrogen and oxygen in molar refraction of a compound, to determine molar mass of volatile liquids by Victor-Meyer method, To determine the specific rotation of sucrose at various concentrations and determine the intrinsic rotation, To determine the heat of solution, heat of hydration and heat of neutralization. To determine the cell constant, verify Ostwald dilution law and perform conductometric titration, to determine rate constant of simple reaction.

Books Recommended:

1. K.J. Laidler, Physical Chemistry with Biological Applications, Current edition, Henjman.
2. W.S. Brey, Physical Chemistry and Its Biological Applications, Current edition Academic Press.
3. J.R. Barrante, Physical Chemistry of the Life Sciences, Current Edition, Printell
4. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, Current edition Shoban Lal Nagin Chand & Co.
5. L.G. Chatten, Pharmaceutical Chemistry, Current Edition, Marcel Dekker, New York
6. A.H. Berkett, J.B. Stenlake, Practical Pharmaceutical Chemistry, Current edition.

PHL 4108 Pharmaceutical Chemistry III (Organic Chemistry I) (4-0-0) Credit 4

PHP 2108 Pharmaceutical Chemistry III (Organic Chemistry I) (0-0-4) Credit 2

Structure and Properties: Organic chemistry, structural theory, chemical bond, quantum mechanics, atomic orbitals, electronic configuration, molecular orbitals, bond lengths, bond angles, bond energy, polarity of bonds, polarity of molecules, dipole moment, structure and physical properties including melting point, boiling point and solubility, acidity and basicity, isomerism. Stereochemistry of Organic Compound: Stereoisomers, enantiomers, diastereoisomers, optical activity, chiral Centre, racemic modification, meso-structures, configuration, reactions involving stereoisomers, stereoselective and stereospecific reactions. Geometric isomers, conformational isomers, configurational isomers, conformational analysis of ethane and n-butane, conformations of cyclohexanes, axial and equatorial bonds, Newman projections, Fischer and Wedge formula, Relative and absolute configuration, sequence rules, D & L, R & S and E & Z system of nomenclature. Alkanes : Nomenclature of straight and branched chain alkanes and alkyl groups, classification of carbon atoms of alkanes, isomerism in alkanes, sources, methods of preparation, physical properties and chemical reactions, Mechanism of free radical halogenation of alkanes, orientation, reactivity and selectivity, chlorofluorocarbons and ozone layer. Cycloalkanes : Nomenclature, methods of preparation, chemical reactions, Bayer's strain theory, ring strain, isomerism in cyclopentane and cyclohexane, reactions of carbenes, cyclic ethers, crown ethers, epoxides. Alkyl Halides: Nomenclature and classes of alkyl halides, methods of preparation, chemical reactions, mechanisms of nucleophilic substitution reactions, SN1 and SN2 reactions, carbonium ions, carbenium ions and carbocations, structure, relative stability, ease of formation, rearrangements and other characteristics of carbocations. Alcohol, Ethers and Role of the Solvent: Nomenclature, methods of preparation, physical properties and chemical reactions. Role of Solvent: Secondary bonding, solubility of non-ionic and ionic solutes, protic and aprotic solvents, ion pairs, role of solvent in substitution reactions, phase-transfer catalysis. Alkenes : Nomenclature, methods of preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, E1 and E2 reaction mechanisms, physical properties and relative stabilities of alkenes, chemical reactions, mechanisms of hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction, epoxidation, ozonolysis, hydration, hydroxylation and oxidation with KMnO₄. Substitution at allylic and vinylic positions, theory of resonance and conjugation, free radical polymerization of alkenes. Dienes : Nomenclature, structures of isolated, conjugated and cumulated dienes, 1, 2- and 1, 4-addition reactions, free radical polymerization of dienes. Alkynes: Nomenclature, structure and bonding in alkynes, method of preparation, chemical reactions, acidity

and electrophilic addition reactions. Benzenes, Arenes and Aromaticity: Nomenclature of benzene and derivatives, structure of benzene, Kekule's structure, stability and length of C-C bond of benzene, resonance structure, aromaticity and Huckel rule, Aromatic electrophilic substitution reactions, mechanisms of nitration, halogenation, sulphonation, Friedal-Crafts reaction, activating and deactivating substituents, orientation and reactivity. Arenes: Nomenclature, method of preparation and reactions of alkynyl benzenes, alkyl benzenes, halogenation of alkylbenzenes- ring vs side chain, stability of benzylic free radical, triphenylmethyl free radical and benzyl cation. Structure, nomenclature, preparation and reactions of alkenyl and alkynyl benzenes.

LAB: Introduction of various laboratory techniques including: Calibration of thermometer, Determination of melting point, Determination of boiling point, Determination of mixed melting point, Distillation, Crystallization, Synthesis of selected organic compounds, Identification of organic compounds and their derivatization, Introduction to the use of stereo models to study: *R* and *S* configuration of enantiomers : *E* and *Z* configuration of geometric isomers.

Books recommended:

1. F.G. Mann and B.C. Saunders, Practical Organic Chemistry, Orient Longman Limited, Hyderabad.
2. B.S. Furniss, A.J. Hannaford, P.W.G. Smith and A.R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, Current edition, Pearson Education Limited (Singapore).

PHL 3110 Anatomy, Physiology & Health Education-I (3-0-0) Credit 3

PHP 2110 Anatomy, Physiology & Health Education-I (0-0-4) Credit 2

Scope of anatomy and physiology, basic medical terminology used in these subjects, Structure of cell, its components and their functions. Elementary Tissues of the Human Body: Epithelial, connective, muscular and nervous tissues, their sub-types and their characteristics. Osseous System: Structure, composition and functions of skeleton, Classification of joints, types of movements of joints, Disorders of joints. Skeletal Muscles: Gross anatomy; physiology of muscle contraction, physiological properties of skeletal muscles and their disorders. Haemopoietic System: Composition and functions of blood and its elements, their disorders, blood groups and their significance, mechanism of coagulation, disorders of platelets and coagulation. Lymph and Lymphatic System: Composition, formulation and circulation of lymph; disorders of lymph and lymphatic system, Basic physiology and functions of spleen. Cardiovascular System: Basic anatomy of the heart, Physiology of heart, blood vessels and circulation. Basic understanding of Cardiac cycle, heart sounds and understanding of Cardiac cycle, heart sounds and electrocardiogram, Blood pressure and its regulation, Brief outline of cardiovascular disorder like hypertension, hypotension, arteriosclerosis, angina, myocardial infarction, congestive heart failure and cardiac arrhythmias.

LAB: Study of human skeleton, Study of different systems with the help of charts and models, Microscopic study of different tissues, Estimation of hemoglobin in blood. Determination of bleeding time, clotting time, R.B.C.Count, Total leucocyte count, D.L.C. and E.S.R. Recording of body temperature, pulse rate and blood pressure, basic understanding of Electrocardiogram-PQRST waves and their significance.

Books Recommended:

1. Tortora, G.J. and Grabowski, S.R.Principles of Anatomy and Physiology Current edition, Collins College Publishers, Luciano, New York
2. Guyton, A.C. & Hall, J.E. W.B. Textbook of Medical Physiology. Current edition, Saunders Co. New York
3. Chatterjee, C.C. Human Physiology, part I&II, Current edition, Medical Allied Agency, Calcutta
4. Waugh, anne & Grant, Ross & Wilson Antomy & Physiology in Health & Illness, Elsevier, Current edition

Semester III			
Course Code	Title of the Course	Hours (L+T+P)	Credit
PHL 3201	Pharmaceutics –II (Unit operation-I)	3+0+0 = 3	3
PHL 4203	Pharmaceutical chemistry-IV (Org chemistry-II)	4+0+0 = 4	4
AML 4203	Pharmaceutical Mathematics	4+0+0 = 4	4
PHL 4205	Pharmaceutical Microbiology	4+0+0 = 4	4
PHL 3207	Anatomy Physiology and Health Education II	3+0+0 = 3	3
PHP 2201	Pharmaceutics –II (Unit operation-I)	0+0+4 =4	2
PHP 2203	Pharmaceutical chemistry-IV (Org chemistry-II)	0+0+4 =4	2
PHP 2205	Pharmaceutical Microbiology	0+0+4 =4	2
PHP 2207	Anatomy Physiology and Health Education II	0+0+4 =4	2
	Total	34	26

Semester IV			
Course Code	Title of the Course	Hours (L+T+P)	Credit
PHL 4202	Pharmaceutics –III (Unit operation-II)	4+0+0 = 4	4
PHL 3204	Pharmaceutical Analysis-II	3+0+0 = 3	3
PHL 4206	Pharmacognosy-III	4+0+0 = 4	4
PHL 4208	Pathophysiology of common diseases	4+0+0 = 4	4
PHL 4210	Pharmaceutics –IV (Physical Pharmacy)	4+0+0 = 4	4
PHP 2202	Pharmaceutics –III (Unit operation-II)	0+0+4 =4	2
PHP 2204	Pharmaceutical Analysis-II	0+0+4 =4	2
PHP 2206	Pharmacognosy-III	0+0+4 =4	2
PHP 2210	Pharmaceutics –IV (Physical Pharmacy)	0+0+4 =4	2
	Total	35	27

Total credit of IInd Courses: 26+27 =53

B. Pharm. Semester – III**PHL 3201 Pharmaceutics-II (Unit Operations I) (3-0-0) Credit 3****PHP 2201 Pharmaceutics-II (Unit Operations I) (0-0-4) Credit 2**

Unit Operations: Introduction, basic laws. Fluid Flow: Types of flow, Reynold's number, Viscosity, Concept of boundary layer, basic equations of fluid flow, valves, flow meters, manometers and measurement of flow and pressure. Material Handling Systems: Liquid handling, Different types of pumps, Gas handling, various types of fans, blowers and compressors, Solid handling, Bins, Bunkers, Conveyers, Air transport. Filtration and Centrifugation: Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter, etc. Factors affecting filtration, mathematical problems on filtration, optimum cleaning cycle in batch filters, Principles of centrifugation, industrial centrifugal filters, and centrifugal sedimenters. Crystallization: Characteristics of crystals like-purity, size, shape, geometry, habit, forms size and factors affecting them, Solubility curves and calculation of yields, Supersaturation theory and its limitations, Nucleation mechanisms, Crystal growth, Study of various types of Crystallizers, tanks, Caking of crystals and its prevention, Numerical problems on yields. Dehumidification and Humidity Control: Basic concepts and definition, wet bulb and adiabatic saturation temperatures, Psychometric chart and measurement of humidity, application of humidity measurement in pharmacy, equipment for dehumidification operations. Principles and applications of refrigeration and air conditioning. Material of Construction and Industrial hazards and Safety Precautions: Mechanical, Chemical, Electrical, fire and dust hazards. Industrial dermatitis, Accident

LAB: Measurement of flow of fluids and their pressure, determination of Reynold's number and calculation of Frictional losses, Evaluation of filter media, determination of rate of filtration and Study of factors affecting filtration, Experiments to demonstrate applications of centrifugation, Thermometers and Psychometric charts, Determination of humidity-use of Dry Bulb and Wet Bulb.

Books Recommended:

1. Badger, W.L. and Banchero, J.T. Introduction to Chemical Engineering. McGraw Hill International Book Co., London.
2. Brown, C.G. Unit Operations (Indian Ed.) CBS Publishers & Distributors.
3. McCabe, W.L. and Smith, J.C. and Harriott, P. Unit Operations of Chemical Engineering. 5th Edition McGraw Hill International Book Co., London.
4. Bhatt N.D. and Panchal, V.M. Machine Drawing Charocar Publishing House, Opp. Amul Dairy, Anand, 388001 (India).

PHL 4203 Pharmaceutical Chemistry-IV (Organic Chemistry-II) (4-0-0) Credit 4**PHP 2203 Pharmaceutical Chemistry-IV (Organic Chemistry-II) (0-0-4) Credit 2**

Aldehydes and Ketones: Nomenclature, preparation of aldehydes and ketones, Friedel-Crafts acylation reaction, oxidation of primary alcohols, oxidation of methyl benzenes and reduction of acid chlorides using organometallic compounds. Reactions of aldehyde and ketones: Oxidation, reduction, addition of Grignard reagents, Cannizzaro reaction, synthesis of organic compounds using Grignard synthesis, planning synthesis starting from alcohols and use of tetrahydropyranyl ethers as protecting agent. Carboxylic Acids: Nomenclature, preparation, physical properties and chemical reactions, ionization of carboxylic acids, structure of carboxylate ions, conversion to acid chlorides, esters and amides, reduction to alcohols, halogenation of aliphatic carboxylic acids (Hell-Vohlard Zenisky reaction), dicarboxylic acids. Functional derivatives of carboxylic acids: Nomenclature, structure, physical properties and chemical reactions, nucleophilic substitution, acyl substitution, preparation of acid chlorides and conversion to acid anhydrides, amides and esters, hydrolysis of these derivatives, transesterification, reaction of esters with Grignard reagents, reduction of esters, functional derivatives of carbonic acids. Reactions involving Carbanions: Acidity of α -hydrogens, acid catalyzed and base promoted halogenation of ketones, Aldol condensation, reactions related to Aldol condensation, Wittig reaction, Claisen condensation, malonic ester and acetoacetic synthesis, direct and indirect alkylation of esters and ketones, synthesis of acids and esters via 2-oxazolines, organoborane synthesis of acids and ketones, alkylation of carbonyl compounds via enamines. Amines: Nomenclature, physical properties, salts of amines, stereochemistry of nitrogen, preparation methods including reduction of nitrocompounds, ammonolysis of halides, reductive amination, Hoffmann degradation of amides, Hoffmann rearrangement, preparation of secondary and tertiary amines. Basicity, effect of structure on basicity, reactions of amines, Hoffmann elimination, conversion to substituted amides, sulphonation of aromatic amines, sulpha drugs, reactions with nitrous acids. Diazonium Salts: Preparation, reactions, replacement with halogens (Sandmeyer reaction), replacement with $-\text{CN}$ (synthesis of carboxylic acids), replacement with $-\text{OH}$ (synthesis of phenols), replacement with H , synthesis using diazonium salts, coupling reactions and synthesis of azo compounds, analysis of amines (Hinsberg test), analysis of substituted amides. Phenols: Nomenclature, structure, physical properties, salts of phenols, preparation, rearrangement of hydroperoxides, acidity, Fries rearrangement, Kolbe reaction, Riemeier-Tiemann reaction, formation and reaction of aryl ethers, analysis of phenols. Nomenclature, structure,

physical properties and chemical reactions, nucleophilic aromatic substitution reactions, low reactivity of aryl and vinyl halides, reactivity and orientation in nucleophilic aromatic substitution, benzyne intermediate. Structure and properties, preparation, interaction of functional groups, electrophilic and nucleophilic addition, Michael addition, Diels-Alder reaction, quinolones. Molecular Orbitals and Symphoria. Macromolecules, polymerization, free radical vinyl polymerization, copolymerization, ionic polymerization and living polymers, coordination polymerization, step-reaction polymerization, structure and properties of macromolecules. Carbohydrates (Monosaccharides, Disaccharides and Polysaccharides), Proteins and Nucleic Acid

LAB: Steam distillation technique for: Separation of *o*- and *p*- nitrophenol, Separation of naphthalene from its suspension in water. Synthesis of organic compounds by: Acetylation (acetyl salicylic acid, acetanilide), Benzoylation (benzamide, benzanilide, phenyl benzoate), Nitration (*p*- nitroacetanilide, 2, 4, 6- trinitrophenol), Halogenation (*p*-bromoacetanilide), Oxidation (benzoic acid from benzyl chloride)

Books Recommended:

1. F.G. Mann and B.C. Saunders, Practical Organic Chemistry, Current Edition, Orient Longman Limited, Hyderabad.
2. B.S. Furniss, A.J. Hannaford, P.W.G. Smith and A.R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, Current Edition, Pearson Education Limited (Singapore).

PHL 4205 Pharmaceutical Microbiology (4-0-0) Credit 4

PHP 2205 Pharmaceutical Microbiology (0-0-4) Credit 2

Historical development and scope of pharmaceutical microbiology, Structure of Bacterial Cell. Classification of Microbes and taxonomy: Actinomycetes, Bacteria, Rickettsiae, spirochetes and viruses. Identification of microbes: Stains and types of staining techniques, electron microscopy. Nutrition, cultivation and Isolation of bacteria, Actinomycetes, fungi and virus. Microbial genetics and variation: Structure of gene, genetic code, transcription, translation, mutation and regulation of gene expression, bacterial enzymes. Control of Microbes by physical and chemical methods: Dynamics of disinfection, factors affecting the process of disinfection, Evaluation of liquid disinfectants & methods of measuring growth inhibition (MIC). Types of chemical agents employed for disinfection, antiseptics and preservation with their full description & use. Principles and Practice of sterilization methods: Introduction, sensitivity of microorganisms, typical survival curves for bacterial spores exposed to moist heat or gamma radiations, expression of resistance in terms of D value and Z value & sterility assurance. Sterilization methods (Heat, Gaseous, Radiations & Filtration using different filter devices) with emphasis on sterilization of items used in hospital, thermolabile drugs and injectable. Monitoring of sterilization processes, Laminar aseptic hoods and aseptic processing. Methods and media used with emphasis of the specific details of the sterility testing of parenteral and ophthalmic and other non-injectable preparations such as catgut etc. Microbial assays of antibiotics, vitamins and amino acids. Immunology

LAB: Experiments devised to prepare various types of culture media, subculturing of common aerobic and anaerobic bacteria, fungus and yeast, various staining methods, various methods of isolation and identification of microbes, sterilization techniques and validation of sterilization techniques, evaluation of antiseptics and disinfectants, testing and sterility of pharmaceutical products as per I.P. requirements, microbial assays of antibiotics, vitamins etc.

Books Recommended:

1. Hugo and Russel. "Pharmaceutical Microbiology", 6th edition, 1998, Balckwell Scientific Publication, Oxford.
2. Prescott LM, Harley GP, Klein DA. "Microbiology". 5th Edition, V.C.Brown Publishers, Oxford.
3. Pelczar MJ, Chan ECS, Krieg NR. "Microbiology", 5th edition, 1993, Tata McGraw Hill Publishing company Ltd., New Delhi.
4. Ananthanarayan R, Panikar CKJ. "Textbook of Microbiology", 5th edition, 1999, Orient Longmann Ltd, Chennnai.
5. Gupte S. The short textbook of Medical Microbiology", 9th edition, 2006, Jaypee Brothers Medical Publishers Ltd New Delhi.
6. Gaud and Gupta, Practical Microbiology, 3rd edition reprint 2008, Nirali Prakashan, Pune
7. Jain, N K, Pharmaceutical Microbiology, current edition, Vallabh Prakashan

PHL 3207 Anatomy, Physiology & Health Education-II (3-0-0) Credit 3

PHP 2207 Anatomy, Physiology & Health Education-II (0-0-4) Credit 2

GIT system and associated endocrines; those of liver, pancreas and gall-bladder various gastrointestinal secretion and their role in the absorption and digestion of food. Anatomy of respiratory organs, functions of respiration, mechanism and regulation of respiration. Functions of different parts of brain and spinal cord, Neurohumoral transmission in the central nervous system, Physiology and functions of the autonomic nervous system, Various parts, structures and functions of the kidney and urinary tract, Male and female reproductive systems and their hormones. Basic anatomy

and physiology of Pituitary, Thyroid, Parathyroid, Adrenals, Pancreas, Testes and Ovary, their hormones and functions, Basic anatomy and physiology of the eye (vision), ear (hearing), taste buds, nose (smell) and skin (superficial receptors). Disease causing agents and prevention of disease, Classification of food requirements, Demography and family planning, Communicable diseases, Emergency treatment of shock, snake bites, burns, poisoning, fractures and resuscitation methods.

LAB: Microscopic studies of different tissues, Simple experiments involved in the analysis of normal and abnormal urine, Collection of specimen, appearance, determination of PH of urine by PH meter, Quantitative determination of Sugars, proteins, urea, lipid profile, uric acid & creatinine, Physiological experiments on nerve-muscle preparations, Determination of vital capacity, experiments of spirometry.

Books Recommended:

1. Tortora, G.J. and Grabowski, S.R. Principles of Anatomy and Physiology. Collins College Publishers, Luciano, New York.
2. Ganong, W.F. Review of Medical Physiology. Prentice-Hall.
2. Parmar, N.S. Health Education and Community Pharmacy, CBS Publishers & Distributors, New Delhi.
3. Ghai, C.L. Textbook of Practical Physiology Jay Pee Brothers, New Delhi.
4. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. W.B. Sanders Co.

AML 4203 Pharmaceutical Mathematics Theory (4-0-0) Credit 4

Algebra, Trigonometry, Calculus: (a) Differential (b) Integral, Measures of central value; mean, mode and median measures of central tendency, measures of dispersion, Standard deviation and standard error of means, coefficient of variation, Elements of binomial and Poisson distributions, Normal distribution curve and properties. Statistical tests; ANOVA, t-Test, chi square test and regression analysis. Probability and significance and methods of determination.

Books Recommended:

1. A Textbook of Mathematics for XI-XII Students. NCERT Publications. Vol I-IV 1991
2. Seshagiri P. Rao, A Textbook of Remedial Mathematics, 1st edition, 2008, Pharma Med Press
3. Schaum's Differential Equations. Mc Graw Hill, Singapore
4. Bolton's Pharmaceutical Statistics. Practical and Clinical Applications. Marcel Dekker, New York, 1990
5. Gupta, S.P. Statistical Methods. Sultan Chand & Co., New Delhi, 1990
6. Bali, N P A Textbook of Pharmaceutical Mathematics, Luxmi Publications

B. Pharm. IV Semester

PHL 4202 Pharmaceutics – III (Unit Operations II) (4-0-0) Credit 4

PHP 2202 Pharmaceutics – III (Unit Operations II) (0-0-4) Credit 2

Stoichiometry : molecular units, mole fraction, gas laws, mole volume, primary and secondary quantities, Heat Transfer : Source of heat, heat transfer, steam and electricity as heating media, determination of requirement of amount of steam/electrical energy, steam pressure, Boiler capacity, Mathematical problems on heat transfer.

Evaporation : Basic concept of phase equilibria, factor affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators, Mathematical problems on evaporation. Distillation: Raoult's law, phase diagrams, volatility; simple steam and flash distillations, principles of rectification, Calculation of number of theoretical plates, Azeotropic and extractive distillation. Drying: Moisture content and mechanism of drying, rate of drying and time of drying calculations, classification and types of freeze drying dryers behaviour of solids during drying, MC, EMC, CMC and LOD dryers used in pharmaceutical industries. Size Reduction and Size Separation: Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of mills including ball mill, hammer mill, fluid energy mill etc. Mixing: Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing equipment.

LAB: Determination of overall heat transfer coefficient, Determination of rate of evaporation, Experiments based on Steam, extractive and azeotropic distillations, Determination of rate of drying, free moisture content and bound moisture content, Experiments to illustrate the influence of various parameters on the rate of drying, Experiments to illustrate principles of size reduction, Laws governing energy and power requirements of size Reduction, Experiments to illustrate solid-solid mixing, determination of mixing efficiency using different types of mixers.

Books Recommended:

1. Badger WL, Banchero JT. "Introduction to Chemical Engineering". McGraw Hill International Book Co., London.
2. Perry RH, Green DW. "Chemical Engineers Handbook", 7th edition, 1998, McGraw Hill, International Editors Ltd,

London.

3. Subramanyam CVS, Setty JT, Suresh S, Devi VK." Pharmaceutical Engineering- Principles & practices", 1st edition, 2002, Vallabh Prakashan , Delhi.
4. Subramanyam CVS, Setty JT, Suresh S, Devi VK." Practical Pharmaceutical Engineering", 1st edition, 2002, Vallabh Prakashan , Delhi.
5. Sudakar Reddy, Pharmaceutical Engineering: Practical Manual (Unit Operations), Pharma Med Press

PHL 3204 Pharmaceutical Analysis-II (3-0-0) Credit 3**PHP 2204 Pharmaceutical Analysis-II (0-0-4) Credit 2**

Non- aqueous Titration: Theoretical consideration, scope and limitations, acid base equilibria in nonaqueous media, titration of weak bases, titration of weak acids, indicators. Complexometric Titrations: Concept of complexation and chelation, Werner's Coordination number and electronic structure of complexions, stability constants, titration curves, masking and demasking agents, types of Complexometric titrations, metal ion indicators, factors influencing the stability of complexes, application. Diazotisation titration, Kjeldahl nitrogen determination, Karl-Fischer titration, Oxygen flask combustion. Extractions Procedures: Separation of drugs from excipients, The Craig method of multiple extraction, continuous counter - current extraction, effect of temperature, pH, inert solute, association, ion-pair formation, the emulsion problems in extractions. Nuclear Chemistry and Radioactivity as an Analytical Tool, Chromatography: Gas chromatography: Introduction; Principles of gas chromatography, basic GLC apparatus, carrier gases; sample introduction, column, column efficiency, solid support, liquid phases, branches of gas chromatography; Detectors, temperature effect; Applications of GLC in Pharmaceutical analysis, HPLC: Introduction, Theory & nomenclature, instrumentation, liquid-solid chromatography; Liquid- liquid chromatography, exclusion chromatography; HPLC columns; Solvent selection in HPLC; Data handling in HPLC, Applications of HPLC, TLC Quantitative Estimation, Ion-Exchange and Molecular Sieve Processes, Theory of ion-exchange, types of exchangers, ion exchange equilibria, ion-exchange capacity, ion-exchange separation, applications in pharmaceutical analysis, molecular sieve separation and applications. Potentiometry, Conductometric and High Frequency Titrations and their Applications, Coulometric Titrations: Its basic principles and Applications, Polarography and Its Applications, Phase Solubility Analysis: Theory, experimental procedures, applications in Pharmaceutical analysis.

LAB: Preparation and standardization of perchloric acid and sodium/ potassium/ lithium methoxides solutions; Estimations of some pharmacopoeial products, Preparations and standardization of EDTA solution, some exercises related to pharmacopoeial assays by complexometric titrations, Miscellaneous Determinations: Exercises involving diazotisation, Kjeldahl, Karl- Fischer, Oxygen flask combustion and gasometry methods. Determination of alcohol content in liquid galenicals, Experiments involving separation of drugs from excipients, Chromatographic analysis of some pharmaceutical products, Exercises based on acid base titration in aqueous and non-aqueous media, oxidation reduction, Titrations using potentiometric technique, Determination of acid-base disassociation constants and plotting of titration curves using pH meter, Exercises involving polarimetry, Exercises involving conductometric and polarographic techniques.

Books Recommended:

1. A.H. Beckett and J.B. Stenlake, Practical Pharmaceutical Chemistry, Vol. I & II, The Athlone Press of the University of London (Latest Edition).
2. J. Bassett, R.C. Denney, G.H. Jeffery & J. Medhan, Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis. The English Language Book Society and Longman (Latest Edition).
3. H. H. Willard, L.L. Merritt; Jr., and J.A. Dean, Instrumental Methods of Analysis, Van Nostrand Reinhold, New York (Latest Edition).
4. L. G. Chatten, Pharmaceutical Chemistry, Vols. I and II, Marcel Dekker, New York (Latest Edition).
5. Braun, Introduction to Instrumental Analysis, I edition, PharmaMed Press
6. Danzer, K., Analytical Chemistry Theoretical and Metrological Fundamentals, Springer

PHL 4206 Pharmacognosy – III (4-0-0) Credit 4**PHP 2206 Pharmacognosy – III (0-0-4) Credit 2**

Study of the biological sources, cultivation, collection, commercial varieties, chemical constituents, substitutes, adulterants & Uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups of drugs containing glycosides; a. Saponins : Liquorice, ginseng, dioscorea, sarsaparilla, and senega. b. Cardioactive sterols: Digitalis, squill, strophanthus and thevetia. c. Anthraquinone cathartics: Aloe, senna, rhubarb and cascara. d. Others: Psoralea, Ammi majus, Ammi visnaga, gentian, saffron, chirata, quassia. Studies of traditional drugs used in Indian system of medicine Amla, Kantkari, Stavari, Gilo (Guruch), Bhilawa, Kalijiri, Bach, Rasna, Punarnava, Chitrack, Apamarg,

Gokhru, Shankhapushpi, Brahmi, Aduśa, Arjuna, Ashoka, Methi, Lahsun, Palash, Guggal, Gymnema, Shilajit, Nagarmotha, kalmegh and Neem. The holistic concept of drug administration in traditional systems of medicine, Introduction to ayurvedic system and ayurvedic preparations like Arishtas, Asvas, Gutikas, Tailas, Churnas, Lehyas and Bhasmas and Standardisation of ayurvedic and herbal products.

LAB: Identification of crude drugs listed in theory, Diagnostic macroscopic and Microscopic study of some important glycoside containing crude drugs, Study of powdered drugs, Standardization of some traditional drug formulations.

Books Recommended:

1. Trease, G. E. and Evans, W.C. Pharmacognosy, Published by Elsevier, a Division of Reed Elsevier India Pvt. Ltd., New Delhi.
2. Kokate, C.K., Purohit, A.P. and Gokhale, S.B Pharmacognosy, Nirali Prakashan, Pune.
3. Harborne, J.B. Phytochemical Methods. Chapman & Hall, International Edition, London.
4. Handa, S.S and Kapoor, V.K. Textbook of Pharmacognosy, Vallabh Prashan, New Delhi.
5. Wallis, T.E. Textbook of Pharmacognosy, Fifth Edition, CBS Publishers and Distributors, New Delhi.
6. Tyler, V.C., Brady, L.R. and Robers, J.E. Pharmacognosy. Lea & Febiger, Philadelphia.
7. Ansari, S.H. Essentials of Pharmacognosy. Third Edition 2009, Birla Publication Pvt. Ltd., Delhi.

PHL 4208 Pathophysiology of Common Diseases (4-0-0) Credit 4

Causes of Cellular injury, pathogenesis, and morphology of cell injury. Intercellular alterations in lipids, proteins and carbohydrates, Cellular adaptation, atrophy, hypertrophy. Alterations in vascular permeability and blood flow, migration of WBCs, acute and chronic inflammation, mediators of inflammation, brief outline of the process of repair. Pathophysiology of Inflammatory Diseases: Rheumatoid arthritis, gout, ulcerative colitis, peptic ulcer, asthma, Pathophysiology of cardiac Disorder: hypertension, angina, congestive heart failure, atherosclerosis, myocardial infarction and arrhythmia, Pathophysiology of diseases of Microbes: various types of Hepatitis, tuberculosis, urinary tract infections, sexually transmitted diseases, AIDS. Pathophysiology of renal diseases: acute and chronic renal failure, Pathophysiology of CNS Disorders: epilepsy, psychosis, depression, mania, Alzheimer disease, Parkinson diseases, Pathophysiology of common diseases: liver cirrhosis, diabetes, anemia, iatrogenic diseases, and common types of neoplasm.

Books Recommended:

1. Cotran, R.S., Kumar, V., Collins, T. Robbins Pathological Basis of Disease. 7th ed. 2003 W.B. Saunders Co. New York
2. Dipro, J.T. et al Pharmacotherapy: A Pathological Approach. 6th ed. 2005 The Mc Graw Hill Companies.
3. Harsh Mohan, Textbook of Pathology. Current edition. Jaypee Publications

PHL 4210 Pharmaceutics IV (Physical Pharmacy) (4-0-0) Credit 4

PHP 2210 Pharmaceutics IV (Physical Pharmacy) (0-0-4) Credit 2

Matter and Properties of Matter: State of matter, change in the state of matter, relative humidity, liquid complexes, liquid crystals, glassy state, solids crystalline, amorphous and polymorphism. Micromeritics and Powder Rheology: Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, measurement, particle shape, specific surface, methods of determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties. Surface and Interfacial Phenomena: Liquid interface, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interfaces, solid-gas and solid liquid interfaces, complex films, electrical properties of interface. Viscosity and Rheology : Newtonian systems, Law of flow, cinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling ball, rotational viscometers. Dispersion Systems: Colloidal Dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy; Suspensions and Emulsions: Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations; Emulsions-types, theories, physical stability. Complexation: Classification of complexes, methods of preparation and analysis, applications. Kinetics and Drug Stability: General considerations & concepts, half-life determination, Influence of temperature, light, solvent, catalytic species and other factors, Accelerated stability study, expiration dating. Buffers: Buffer equations and buffer capacity in general, buffers in pharmaceutical systems,

preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.

LAB: Determination of particle size, particle size distribution and surface area using various methods of Particle size analysis, Determination of derived properties of powders like densities, porosities, compressibility, angle of repose, Determination of surface/interfacial tension, spreading coefficient HLB value, and critical micellar concentration of surfactants, Study of rheological properties of various types of systems using different Viscometers, Preparation of various types of suspensions and determination of their sedimentation parameters, Preparation and stability studies of emulsions, Studies on different types of complexes and determination of their stability constants, Accelerated stability testing, shelf-life determination and expiration dating of pharmaceuticals, Preparation of pharmaceutical buffers and determination of buffer capacity, Experiments involving tonicity adjustments.

Books Recommended:

1. Sinko PJ. "Martin's. Physical pharmacy & Pharmaceutical sciences", 5th edition, 2006, B.I. Publications Pvt Ltd, New Delhi.
2. Carter SJ. "Cooper & Gunn's Tutorial Pharmacy", 6th edition, 200, CBS Publishers & Distributors, New Delhi.
3. Remington's The Science & Practice of Pharmacy Mack Publishing Co. Easton, PA
4. Gaud and Gupta " Practical Physical Pharmacy", I edition, reprint 2008, CBS Publisher and Distributor, New Delhi
5. Subhramanyam CVS. "Textbook of Physical Pharmaceutics", 2nd edition, 2007, Vallabh Prakashan, New Delhi.

Semester V			
Course Code	Title of the Course	Hours (L+T+P)	Credit
PHL 3301	Pharmaceutical chemistry-V (Biochemistry)	3+0+0 = 3	3
PHL 4303	Pharmaceutics –V (Pharmaceutical Technology –I)	4+0+0 = 4	4
PHL 4305	Pharmacology –I	4+0+0 = 4	4
PHL 3307	Pharmacognosy-IV	3+0+0 = 3	3
PHL 3309	Pharmaceutics –VI (Hospital Pharmacy)	3+0+0 = 3	3
PHP 2301	Pharmaceutical chemistry-V (Biochemistry)	0+0+4 =4	2
PHP 2303	Pharmaceutics –V (Pharmaceutical Technology –I)	0+0+4 =4	2
PHP 2305	Pharmacology –I	0+0+4 =4	2
PHP 2307	Pharmacognosy-IV	0+0+4 =4	2
PHP 2309	Pharmaceutics –VI (Hospital Pharmacy)	0+0+4 =4	2
	Total	37	27

Semester VI			
Course Code	Title of the Course	Hours (L+T+P)	Credit
PHL 3302	Pharmaceutical chemistry-VI (Med Chemistry-I)	3+0+0 = 3	3
PHL 3304	Pharmaceutical Jurisprudence	3+0+0 = 3	3
PHL 4306	Pharmaceutics VII (Biopharmaceutics & Pharmacokinetics)	4+0+0 = 4	4
PHL 4308	Pharmacology –II	4+0+0 = 4	4
PHL 3310	Pharmacognosy-V	3+0+0 = 3	3
GEL 3101	Environmental Sciences	3+0+0 = 3	3
PHP 2302	Pharmaceutical chemistry-VI (Med Chemistry-I)	0+0+4 =4	2
PHP 2306	Pharmaceutics VII (Biopharmaceutics & Pharmacokinetics)	0+0+4 =4	2
PHP 3308	Pharmacology –II	0+0+6 =6	3
PHP 2310	Pharmacognosy-V	0+0+4 =4	2
	Total	38	29

B. Pharm. V Semester**PHL 3301 Pharmaceutical Chemistry-V (Biochemistry) (3-0-0) Credit 3****PHP 2301 Pharmaceutical Chemistry-V (Biochemistry) (0-0-4) Credit 2**

Biochemical organization of the cell and transport process across cell membrane, The concept of free energy, bioenergetics, production of ATP and its biological significance, Enzymes and coenzymes, Carbohydrate Metabolism, Glycolysis and fermentation and their regulation, gluconeogenesis and glycogenolysis, Metabolism of galactose and galactosemia, role of sugar nucleotides in biosynthesis, and Pentosephosphate pathway, The Citric Acid Cycle. Lipids Metabolism: Oxidation of fatty acids, β -oxidation & energetic, β -oxidation, β -oxidation, Biosynthesis of ketone bodies and their utilization, Biosynthesis of saturated and unsaturated fatty acids, Control of lipid metabolism, Essential fatty acids & eicosanoids (prostaglandins, thromboxanes and leukotrienes), phospholipids, and sphingolipids., Biological Oxidation, Nitrogen & Sulphur Cycle, Metabolism of Ammonia and Nitrogen Containing Monomers: Nitrogen balance, Biosynthesis of amino acids, Catabolism of amino acids, Conversion of amino acids to specialized products, Assimilation of ammonia, Urea cycle, metabolic disorders of urea cycle, Metabolism of sulphur containing amino acids, Porphyrin biosynthesis, formation of bile pigments, hyperbilirubinemia, Purine biosynthesis, Purine nucleotide interconversion, Pyrimidine biosynthesis and Formation of deoxyribonucleotides. Biosynthesis of Nucleic Acids: Brief introduction of genetic organization of the mammalian genome, alteration and rearrangements of genetic material, Biosynthesis of DNA and RNA. Genetic Code and Protein Synthesis, Brief account of genetic engineering and polymerase chain reactions, Regulation of gene expression.

LAB: Preparation of standard buffers (citrate, phosphate and carbonate) and measurement of pH, Titration curve for amino acids, Separation of amino acids by two dimensional paper chromatography and gel electrophoresis, Separation of lipids by TLC, Separation of serum proteins by electrophoresis on cellulose acetate, Quantitative estimation of amino acids, Quantitative estimation of proteins, Determination of glucose by means of the enzyme glucose oxidase, Enzymatic hydrolysis of glycogen by α - and β - amylases, Isolation and determination of RNA and DNA, Effect of temperature on the activity of α -amylase, Estimation of SGOT, SGPT, Alkaline phosphatase and Bilirubin in the serum.

Books Recommended:

1. Conn, E.E. and Stump, P.K. Outlines of Biochemistry. John Wiley & Sons, New York.
2. Jayaraman, J. Laboratory Manual in Biochemistry. Wiley Eastern Ltd., New Delhi
3. Lehninger, A.L. Biochemistry, Worth Publisher, Inc.
4. Plumer, D.T. An Introduction to Practical Biochemistry. Tata McGraw Hill, New Delhi.
5. Harper's Biochemistry, Lange Publishing Group.
6. Satyanarayana, U. Biochemistry, 3rd Edition, Books & Allied Publications

PHL 4303 Pharmaceutics-V (Pharmaceutical Technology I) (4-0-0) Credit 4**PHP 2303 Pharmaceutics-V (Pharmaceutical Technology I) (0-0-4) Credit 2**

Liquid Dosages Forms: Introduction, types of additives used in formulations, Vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers, colors, flavours and others, manufacturing packaging and evaluation of clear liquids, syrups, suspensions and emulsions official in pharmacopoeia. Semisolid Dosage Forms: Definitions, types, mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selection. General formulation of semisolids, clear gels manufacturing procedure, evaluation and packaging. Suppositories: Classification, Ideal requirements, bases, manufacturing procedure, packaging and evaluation. Blood Products and Plasma Substitutes: Collection, processing and storage of whole human blood, concentrated human RBCs, dried human plasma, human fibrinogen, human thrombin, human normal immunoglobulin, human fibrin foam, plasma substitutes, ideal requirements, PVP, dextran etc. for control of blood pressure as per I.P. Pharmaceutical Aerosols: Definition, propellants, general formulation, manufacturing and packaging methods, pharmaceutical applications. Ophthalmic Preparations: Requirements, formulation, methods of preparation, containers, evaluation. Cosmeticology and Cosmetic Preparations: Fundamentals of cosmetic science, structure and functions of skin and hair. Formulation, preparation and packaging of cosmetics – deodorants and antiperspirants, shampoo, face powder, dentifrice, nail polish, Lipsticks, eye lashes and baby care products.

LAB: Preparation, evaluation and packaging of liquid orals like solutions, suspensions and emulsions, ointments, suppositories, aerosols, eye drops, eye ointments etc. Preparation of pharmacopoeial extracts and galenical products utilizing various methods of Extraction. Formulation of various types of cosmetics for skin, hair, dentifrices and manicure preparations.

Books Recommended:

1. Aulton ME. "Pharmaceutics- The Science of Dosage Form Design", 1st edition, 1998, ELBS/Churchill Livingstone, New York.
2. Lachman L, Lieberman HA, Kanig JL." The Theory & Practice of Industrial Pharmacy", 3rd edition, 1991, Varghese Publishing House, Bombay.
3. Banker GS, Rhode CT. "Modern Pharmaceutics", 4th edition, Informa Healthcare, New York.
4. Allen LV, Popovich NG, Ansel HC", Ansel's pharmaceutical Dosage Forms & Drug Delivery Systems", 8th edition, 2005.
5. Sagarin, Balsam MS." Cosmetic Science & Technology", Vol. 1-3 2nd ed. John Wiley.
6. Balsam SM AND Edward, Cosmetics : Science and Technology, 2nd edition, 2008, Willey.
7. Butter H., Poucher's Perfumes Cosmetics and Soaps, 10th edition, 2007, Springer

PHL 4305 Pharmacology I (4-0-0) Credit 4

PHP 2305 Pharmacology I (0-0-4) Credit 2

General Pharmacology, Pharmacology of Peripheral Nervous System: Neurohumoral, Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics and drug acting on autonomic ganglia. Neuromuscular blocking Agents, Local anesthetic Agents, Pharmacology of Central Nervous System: a Neurohumoral transmission in the C.N.S., General Anesthetics, Aliphatic Alcohols and disulfiram, Sedatives, hypnotics, Anti-anxiety agents and Centrally acting muscle relaxant, Anti psychotics, antidepressants, anti manics and hallucinogens, Anti-epileptics drugs, antiparkinsonian Drugs. Analgesics, Antipyretics, Anti-inflammatory and Anti-gout drugs, Narcotic analgesics and antagonists, CNS stimulant, Drug Addiction and Drug Abuse

Lab: Introduction of Experimental Pharmacology, Preparation of different solutions for experiments, Drug dilutions, use of molar and w/v solutions in experimental Pharmacology, Common laboratory animals and anesthetics used in animal studies, Commonly used instruments in experimental pharmacology, Some common and standard techniques, Bleeding and intravenous injection, intragastric administration. Procedures for rendering animals unconscious- stunning of rodents, various methods of euthanasia, Experiments of intact preparations: Study of different routes of administration of drugs in mice/rats, To study the effect of hepatic microsomal enzyme inhibitors and induction on the pentobarbitone sleeping time in mice, Experiments on Central Nervous system: Recording of spontaneous motor activity, stereotypy, analgesia, anticonvulsant activity, anti-inflammatory activity, and muscle relaxant activity of drugs using simple experiments, Effects of autonomic drugs on rabbit's eye, Effect of various agonists and antagonists and their characterization using isolated ileum and fundus preparations of rat.

Books Recommended:

1. Gilman, A.G., Goodman, L.S., Goodman and Gilman's The Pharmacological Basis of Therapeutics. 11th ed. 2006 Editors J.G. Hardman et al. Pergamon Press, New York
2. Tripathi K.D. Essential of Medical Pharmacology. 6th ed. 2008. Jaypee brother medical publisher. New Delhi
3. Harvey AR, Champ CP Pharmacology 3rd Ed. 2006 Lippincott Williams & Wilkins Philadelphia
4. Ghosh, M.N Fundamentals of Experimental Pharmacology. 4th ed. 2008, Scientific Book Agency, Kolkata.
5. Kulkarni, S.K. Handbook of Experimental Pharmacology. 2nd ed. 1997 Vallabh Prakashan, Delhi

PHL 3307 Pharmacognosy-IV (3-0-0) Credit 3

PHP 2307 Pharmacognosy-IV (0-0-4) Credit 2

Systematic study of source, cultivation, collection, processing, commercial varieties, chemical constituents, substitutes, adulterants, uses, and specific chemical tests of following alkaloid containing drugs: Pyridine - piperidine: Tobacco, areca and lobelia, Tropane: Belladonna, hyoscyamus, datura, duboisia, coca and withania, Quinoline and isoquinoline: cinchona, ipecac, opium, Indole: Ergot, rauwolfia, catharanthus, nux-vomica and physostigma, Imidazole: Pilocarpus, Steroidal: Veratrum and kurchi, alkaloidal amine: Ephedra and colchicum, Glycoalkaloid: Solanum, Purines Coffee, tea and cola, Role of medicinal and aromatic plants in national economy, Biological sources, preparation, identification tests and uses of the following enzymes: Diastase, papain, pepsin, trypsin, pancreatin, General biosynthetic pathways of natural products like alkaloids, glycosides, terpenoids, lignans, quassinoids, carotenoids and flavonoids, Plant bitters and sweeteners, Introduction, classification and study of different chromatographic methods and their applications in evaluation of herbal drugs.

LAB: Identification of crude drugs listed above, Diagnostic macroscopic and microscopic study of characters of eight-selected drugs given in theory in entire and powdered form, Chemical Evaluation of powdered drugs, and enzymes, Chromatographic studies of some herbal constituents.

Books Recommended:

1. Trease, G. E. and Evans, W.C. Pharmacognosy, Published by Elsevier, a Division of Reed Elsevier India Pvt. Ltd., Delhi
2. Kokate, C.K., Purohit, A.P. and Gokhale, S.B Pharmacognosy, Nirali Prakashan, Pune.
3. Handa, S.S and Kapoor, V.K. Textbook of Pharmacognosy, Vallabh Prashan, New Delhi.
4. Medicinal Plants of India. ICMR, New Delhi.
5. Wallis, T.E. Textbook of Pharmacognosy, Fifth Edition, CBS Publishers and Distributors, New Delhi.
6. Tyler, V.C., Brady, L.R. and Robers, J.E. Pharmacognosy. Lea & Febiger, Philadelphia.

PHL 3309 Pharmaceutics VI (Hospital Pharmacy) (3-0-0) Credit 3

PHP 2309 Pharmaceutics VI (Hospital Pharmacy) (0-0-4) Credit 2

Organization & Structure, Hospital Formulary, Drug Store Management and Inventory Control: Organization of drug store, Types of materials stocked, storage conditions, Purchase and Inventory Control-principles, purchase procedures, Purchase order, Procurement and stocking. Drug distribution System in Hospitals: Outpatient dispensing, methods adopted, Dispensing of drugs to in-patients, Types of drug distribution systems, Charging policy, labeling, Dispensing of drugs to ambulatory patients, Dispensing of controlled drugs, Central Sterile Supply Unit and their Management: Types of materials for sterilization, packing of materials prior to sterilization, sterilization equipment, Supply of sterile materials, Manufacture of Sterile and Non-sterile Products: Policy making of manufacturable items, demand and costing, personnel requirements, manufacturing practice, Master formula Card, production control, manufacturing records., Drug Information Services, Records and Reports: Prescription filling, drug profile, patient medication profile, cases on drug interaction and adverse reactions, reporting methods, idiosyncratic cases etc., Nuclear Pharmacy: Introduction to Radio pharmaceuticals, radio-active half-life, Units of radio-activity Production of radio-pharmaceuticals, Permissible radiation dose level, Radiation hazards and their prevention, specifications for radio-active laboratory.

LAB: Experiments based on Sterilization of various types of materials used in Hospitals, Practical designed on the use of computers in Drug Information Center, prescription filling, documentation of information on drug interaction, Preparation and quality control of i.v. fluids and i.v. admixtures. Case studies of prescriptions regarding drug interactions, drug dosage corrections, suggesting antidotes for poisoning cases, managing ADR, etc.

Books Recommended:

1. Owunwonne Handbook of Radio pharmaceuticals. Narosa Publishing House, New Delhi.
2. Hassan, William E. Hospital Pharmacy. Lea & Febiger, Philadelphia.
3. Remington's The Science & Practice of Pharmacy Mack Publishing Co. Easton, PA
4. Turco. S, and King, R.E. Sterile Dosage Forms. Lea & Febiger, Philadelphia.
5. www.nhs.uk

B. Pharm. VI Semester

PHL 3302 Pharmaceutical Chemistry-VI (Medicinal Chemistry-I) (3-0-0) Credit 3

PHP 2302 Pharmaceutical Chemistry-VI (Medicinal Chemistry-I) (0-0-4) Credit 2

Physicochemical and Stereochemical aspects of drugs including bioisosterism in relation to biological activity, Drug-Receptor interaction, Conventional methods of drug design, Lead, Discovery of Lead, lead optimization, Vitamins: Water soluble and fat soluble vitamins, Introduction, Structure, Stereochemistry, Nomenclature, Synthesis of specified drugs (given in parenthesis), mode of action, Structure Activity Relationships (if any) uses and Physicochemical properties of the following classes of drugs: Adrenergic hormones and drugs including biosynthesis, storage, release and metabolism of Catecholamine (Isoprenaline, Adrenaline, Salbutamol), Cholinergic and Anticholinesterases including biosynthesis, storage, release and metabolism of acetylcholine (Neostigmine bromide, Pyridostigmine Bromide), Antispasmodic and Antiulcer drugs (Propantheline bromide, Dicyclomine hydrochloride), Antiparkinsonism drugs (levodopa and carbidopa), Neuromuscular blocking agents (Succinylcholine chloride, Gallamine triethiodide), Antihistamines including Sodium Cromoglycate (Chloropheniramine), Prostaglandins and other Eicosanoids: Nomenclature, biosynthesis and biological activity, Analgesic-antipyretics and Non-steroidal Anti-inflammatory agents: (Indomethacin, and Diclofenic sodium).

LAB: Exercises based on QSAR, Synthesis of selected drugs from the course content, Spectral analysis of the drugs synthesized, Establishing the pharmacopoeial standards of the drugs synthesized, Determination of partition coefficient, dissociation constant and molar.

Books Recommended:

1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, Eleventh Edition, edited by J. H. Block and J. M. Beale Jr., Lippincott Williams & Wilkins, Philadelphia, 2004.
2. Pharmaceutical Chemicals in Perspective, B.G. Reuben and H.A. Wittcoff, John Wiley & Sons, New York, 1989.
3. Foye's, Principles of Medicinal Chemistry, Sixth Edition, Wolters Kluwer (India), Lea & Febiger, Philadelphia, USA, 2008.
4. Hansch, C. Comprehensive medicinal Chemistry Vol.IV, Quantitative Drug Design. Pergamon Press, Oxford.
5. Singh, H. and Kapoor, V.K. Medicinal and Pharmaceutical Chemistry, Second Edition Vallabh Prakashan, Delhi, 2005.
6. Povl Krogsgaard, Tommy, Textbook of Drug Design & Discovery, 3rd edition, 2004,

PHL 3304 Pharmaceutical Jurisprudence & Ethics (3-0-0) Credit 3

Pharmaceutical Legislations- A brief review, Drugs & Pharmaceutical Industry- A brief review, Pharmaceutical Education- A brief review, Code of Pharmaceutical Ethics, Pharmacy Act 1948, Drugs and Cosmetics Act 1940 and Rules 1945, Medicinal & Toilet Preparations (Excise Duties) Act 1955, Narcotic Drugs & Psychotropic Substances Act 1985 & Rules, Drugs Price Control Order, Poisons Act 1919, Drugs and Magic Remedies (Objectionable Advertisements) Act 1954, Medical Termination of Pregnancy Act 1970 & Rules 1975, Prevention of Cruelty to Animals Act 1960, States Shops & Establishments Act & Rules, Insecticides Act 1968, AICTE Act 1987, Factories Act 1948, Minimum Wages Act 1948, Patents Act 1970.

Books Recommended:

1. Jain, N.K.A Textbook of Forensic Pharmacy. Vallabh Prakashan, New Delhi.
2. Mithal, B.M. A Textbook of Forensic Pharmacy. National Book Depot, Kolkatta.
3. Kokate and Gokhale, Textbook of Forensic Pharmacy, 2006, Pharma Book Syndicate, Hyderabad

PHL 4306 P'ceutics VII (Biopharmaceutics and P'cokinetics) (4-0-0) Credit 4

PHP 2306 P'ceutics VII (Biopharmaceutics and P'cokinetics) (0-0-4) Credit 2

Biopharmaceutics and Pharmacokinetics and their role in formulation development and clinical setting, Passage of drugs across biological barrier (passive diffusion, active transport, facilitated diffusion and pinocytosis), Factors influencing absorption- Physicochemical, physiological and pharmaceutical, Drug distribution in the body, plasma protein binding, Significance of plasma drug concentration measurement, Compartment and model-Definition and Scope, Pharmacokinetics of drug absorption – Zero order and first order absorption rate constant using Wagner – Nelson and Loo- Reigelman method, Volume of distribution and distribution coefficient, Compartment kinetics- one compartment and two compartment models, Determination of pharmacokinetic parameters from plasma and urine data after drug administration by intravascular and oral route, Curve fitting (method of Residuals), regression procedures, Clearance concept, Mechanism of renal clearance, clearance ratio, Determination of renal clearance, Extraction ratio, hepatic clearance, biliary excretion, Extra hepatic circulation, Non-linear pharmacokinetics with special reference to one compartment model after I.V. drug administration, Michaelis Menten Equation, detection of non-linearity (Saturation mechanism), Non-Compartmental concept of mean residence time (MRT), Measures of bioavailability, C_{max}, t_{max} and area under the curve (AUC), Design of single dose bioequivalence study and relevant statistics, Review of regulatory requirements for conduct of bioequivalent studies (WHO ICH Guidelines).

LAB: Experiments designed for the estimation of various pharmacokinetic parameters with given data, Analysis of biological specifications for drug content and estimation of the pharmacokinetic parameters, In vitro evaluation of different dosage forms for drug release, Absorption studies –in vitro and in situ, Statistical treatment of pharmaceutical data.

Books Recommended:

1. Notari, R.E. Biopharmaceutics & Pharmacokinetics- An Introduction. Marcel Dekker.
2. Rowland, M. and Tozer, T.N. Clinical Pharmacokinetics. Lea & Febiger, N.Y.
3. Gibaldi, M. Biopharmaceutics and Clinical Pharmacokinetics. 4th edition, 2008, PharmMed Press.
4. Shargel, L. and Yu, A. Applied Biopharmaceutics and Pharmacokinetics. Appleton & large, Norwalk.
5. Wagner, J.G. Fundamentals of Clinical Pharmacokinetics. Drug Intelligence Publications, Hamilton.
6. Stephen H. Curry, Drug Disposition and Pharmacokinetics, 3rd edition 2008, Pharm Med Press



PHL 4308 Pharmacology II (4-0-0) Credit 4

PHP 3308 Pharmacology II (0-0-6) Credit 6

Pharmacology of Cardiovascular System: Digitalis, other cardiac glycosides and drugs for heart failure, Antihypertensive drugs, Antianginal and Vasodilator drugs, including calcium channel blockers and beta adrenergic antagonists, Antiarrhythmic drugs, Antihyperlipidemic drugs, Drugs used in the therapy of shock, Drugs Acting on the Hemopoietic System: Hematinics, Anticoagulants, Vitamin K and hemostatic agents, Fibrinolytic and anti-platelet drugs, Blood and plasma volume expanders, Drugs acting on urinary system: Diuretics, Autacoids: Histamine, 5- HT and their antagonists, Prostaglandins, thromboxanes and leukotrienes, Drugs Acting on the Respiratory System: Anti-asthmatic drugs including bronchodilators, Anti-tussives and expectorants, Respiratory stimulants.

LAB: Experiments on Isolated Preparations: The CRC of 5- HT on rat fundus preparation, the CRC of histamine on guinea pig ileum preparation, the CRC of oxytocin using rat uterus preparation, Pharmacology of Cardiovascular System: study the inotropic and chronotropic effects of drugs on isolated rat heart, study the effects of drugs on normal and hypodynamic frog heart using software, Blood Pressure of anaesthetized Rat : To demonstrate the effects of various drugs on the B.P. and respiration including the Vasomotor Reversal of Dale and nicotinic action of acetylcholine using software.

Books Recommended:

1. Gilman, A.G., Goodman, L.S., Goodman and Gilman's The Pharmacological Basis of Therapeutics. 11th ed. 2006 Editors J.G. Hardman et al. Pergamon Press, New York
2. Tripathi K.D. Essential of Medical Pharmacology. 6th ed. 2008. Jaypee brother medical publisher. New Delhi
3. Katzung B.G. Basic & Clinical Pharmacology 4th ed. 2008 Churchill Livingstone New York
4. Rang M.P., Dale M.M. and Ritter, J.M. Pharmacology. 6th ed. 2007 Churchill Livingstone. London.
5. Harvey AR, Champ CP Pharmacology 3rd Ed 2006 Lippincott Williams & Wilkins Philadelphia

PHL 3310 Pharmacognosy – V (Chemistry of Natural Products) (3-0-0) Credit 3

PHP 2310 Pharmacognosy – V (Chemistry of Natural Products) (0-0-4) Credit 2

Chemical and spectral approaches to characterize molecules of natural origin, Concept of stereoisomerism taking examples of natural products, Chemistry, and pharmacological activity of medicinally important terpenoids: monoterpenes, sesquiterpenes, diterpenes, and triterpenoids, Carotenoids: carotenoids, b- carotenes, vitamin A, Xanthophylls of medicinal importance, Glycosides: Chemistry, pharmacological activity of digitoxin, digoxin, hederagenin, sennosides, diosgenin and sarsapogenin, Alkaloids: Chemistry, and pharmacological activity of atropine and related compounds; quinine, reserpine, morphine, papaverine, ephedrine, ergot and vinca alkaloids, Chemistry and pharmacological activity of medicinally important lignans, quassinoids and flavonoids. Chemistry and therapeutic activity of penicillin, streptomycin and tetracycline

LAB: Laboratory experiments on isolation, separation, and purification of various groups of chemical constituents of pharmaceutical significance, Exercises on paper and thin layer chromatographic evaluations of herbal drug constituents.

Books Recommended:

1. Trease, G. E. and Evans, W.C. Pharmacognosy, Published by Elsevier, a Division of Reed Elsevier India Pvt. Ltd., Delhi
2. Beckett, A.H. and Stenlake, J.B. Practical Pharmaceutical Chemistry, Fourth Edition- Part Two, CBS Publishers and Distributors, New Delhi.
3. Chatwal, G.R. and Anand, S.K. Instrumental Methods of Chemical Analysis, Himalaya Publishing House, New Delhi.
4. Wallis, T.E. Textbook of Pharmacognosy, Fifth Edition, CBS Publishers and Distributors, New Delhi.
5. Jackson, B.P. and Snowdon, D.W. Atlas of Microscopy of Medicinal Plants Culinerbs and Spices, CBS Publishers & Distributors (P) Ltd., New delhi.

GEL 3101 Environmental Sciences (3-0-0) Credit 3

The Multi disciplinary Nature of Environmental Studies: Definition, Scope and Importance, Need for Public Awareness.

Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems. Forest resources: Use and over exploitation, deforestation, case studies, Timber extraction, mining, dams and other effects on forest and tribal people. Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams, benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources: Equitable use of resources for sustainable

lifestyles. Ecosystems: Concept of an ecosystem: Structure and function of an ecosystem, Producers, consumers and decomposers, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystems: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity and its conservation: Introduction - Definition: genetic, species and ecosystem diversity. Bio-geographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega diversity nation, Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts. Endangered and endemic species of India, Conservation of biodiversity: Insitu and Ex-situ conservation of biodiversity. Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards. Solid waste Management, Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides. Social Issues and the Environment: Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, and watershed management, Resettlement and rehabilitation of people; its problems and concerns. Human Population and the Environment: Population growth, variation among nations. Population explosion, Family Welfare Programme, Environment and human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of information Technology in Environment and human health. Field work: Visit to a local area to document environmental assets River /forest grassland/hill/mountain. Visit to a local polluted site, Urban/Rural/industrial/ Agricultural Study of common plants, insects, and birds. Study of simple eco systems pond, river, hill slopes, etc.

Books Recommended:

1. Textbook of Environmental Sciences and Technology by M. Anji Reddy, BS Publication.
2. Environmental Law by S.K. Mohanty (Universal Law Publications)
3. Pollution control acts, rules and notifications issues, there under by CPCB
4. [Ministry of and Environment and forest, Govt. of India] Paryavaran Bhawan, CGO Complex, New Delhi-110003.

Semester VII			
Course Code	Title of the Course	Hours (L+T+P)	Credit
PHL 4401	Pharmaceutical Biotechnology/ Drug Regulations/ Clinical Trials Management	4+0+0 = 4	4
PHL 4403	Pharmaceutics VIII (Pharm. Tech-II)	4+0+0 = 4	4
PHL 4405	Pharmaceutical Industrial Management	4+0+0 = 4	4
PHL 4407	Pharmacology –III	4+0+0 = 4	4
PHL 3409	Pharmaceutical Chemistry-VII (Medicinal Chemistry-II)	3+0+0 = 3	3
PHP 2403	Pharmaceutics VIII (Pharm. Tech II)	0+0+4 =4	2
PHP 2407	Pharmacology –III	0+0+4 =4	2
PHP 2409	Pharmaceutical Chemistry-VII (Medicinal Chemistry-II)	0+0+4 =4	2
PHS 2411	Elective Project work	0+0+4 =4	2
	Total	35	27

Semester VIII			
Course Code	Title of the Course	Hours (L+T+P)	Credit
PHL 4402	Pharmaceutics –IX (Dosage form Design)	4+0+0 = 4	4
PHL 4404	Pharmaceutical Analysis-III	4+0+0 = 4	4
PHL 4406	Pharmaceutical chemistry-VIII (Medicinal Chemistry-III)	4+0+0 = 4	4
PHL 3408	Pharmacognosy-VI	3+0+0 = 3	3
PHL 4410	Pharmacology –IV (Clinical Pharmacy and Drug Interaction)	4+0+0 = 4	4
PHP 2402	Pharmaceutics –IX (Dosage form Design)	0+0+4 =4	2
PHP 2404	Pharmaceutical Analysis-III	0+0+4 =4	2
PHP 2406	Pharmaceutical chemistry-VIII (Medicinal Chemistry-III)	0+0+4 =4	2
PHP 2408	Pharmacognosy-VI	0+0+4 =4	2
PHS 2412	Dissertation on the project	0+0+4 =4	2
	Total	39	29

Total credit of IVth yr Courses: 29+27 =56

B. Pharmacy VII Semester**PHL 4401 Pharmaceutical Biotechnology (4-0-0) Credit 4**

Definition and application of biotechnology in pharmaceutical sciences, Immunology: Principles cellular & humoral immunity, antigens and haptens, MHC, immunological tolerance, Culturing Microorganisms: Batch culture, continuous culture, Fed-batch culture and use of culture system for the production of microbial products, Genetic Recombination: Transformation, conjugation, transduction, protoplast fusion and gene cloning and their applications. Development of hybridoma for monoclonal antibodies. Study of drugs produced by biotechnology such as Activase, Insulin, Streptokinase Humatrope, Hepatitis B vaccine etc., Fermentation Technique: Introduction of fermentation, fermenter technology, control of different parameters. Isolation of mutants, factors influencing rate of mutation. Design of fermentation process, Isolation of fermentation products - penicillins, streptomycins, tetracyclines, vitamin B12 & ethanol, Microbial Transformation: Introduction, types of reactions mediated by microorganisms, design of biotransformation processes, selection of organisms, biotransformation process and its improvements with special reference to steroids, Enzyme immobilization : Techniques of immobilization of enzymes, factors affecting enzyme kinetics, Study of enzymes such as hyaluronidase, penicillinase, streptokinase and streptodornase, amylases and proteases etc. and immobilization of bacteria and plant cells.

Books recommended:

1. Trevan, Boffey, Goulding and Stanbury, Biotechnology the Biological Principles, Tata McGraw Hill.
2. Hugo and Russel. "Pharmaceutical Microbiology", 6th edition, 1998, Balckwell Scientific Publication, Oxford.
3. Trevan MD, Boffey S, Goulding KH, Stanbury P." Biotechnology- The Biological Principles ", 1st edition, 1998, Tata McGraw Hill , New Delhi.
4. Crueger W, Crueger A." Biotechnology", 2nd edition, 2000, Panima Publishing Corporation, New Delhi.
5. Vyas SP, Dixit VK."Pharmaceutical Biotechnology", 1st edition ,2007, CBS Publishers & Distributors, New Delhi
6. Ward, O.P. "Fermentation Technology, Principles, Processes & products" Open University press, Milton Keynes, U.K.
7. Gaud, Gupta and Gokhale, Practical Biotechnology, 3rd edition, 2008, Nirali Prakashan, Pune

PHL 4401 Drug regulations (4-0-0) Credit 4

Drug Regulatory Agencies-Historical perspectives, organization structure activities & responsibilities: India, US, EU, Japan. (WHO, US-FDA, UK-MCA, TGA), Registration and approval of new products: IND, NDA and other processes, Drug Master File and Material Safety Data Sheet (MSDS) preparation, Guide lines for filing in countries like US & EU, Management of Intellectual Property in Drugs & Pharmaceuticals, Indian Patent Act 1970 and amendments there under, Copyright (Indian) Act, Consumer Protection Act, Good Clinical Practice Guideline, Good Laboratory Practice Guidelines, GMP Guidelines, standard & certification agencies like ISI, BSS, ASTM, ISO.

References: Reference to websites; CDSCO, US FDA, TGA. MHRA, EMEA, IP.

PHL 4401 Clinical Trials Management (4-0-0) Credit 4

IND application, ANDA application, Phase I-Phase IV structure, Investigator's Brochure, Sponsor, Monitors and auditors IEC/IRB, Protocol design, Validation of methods, Sample selection and rejection, Informed Consent, Codification and Decoding process, Remuneration policy, Statistical Analysis, Summarisation and Conclusion and NDA filing, Pharmacovigilance and ADR reporting.

PHL 4403 Pharmaceutics- VIII (Pharmaceutical Technology- II) (4-0-0) Credit 4**PHP 2403 Pharmaceutics- VIII (Pharmaceutical Technology- II) (0-0-4) Credit 2**

Capsules: Introduction, types, advantages and disadvantages, material and method of preparation hard gelatin capsules, size of capsules, method of capsule filling, soft gelatin, capsule shell and capsule content, importance of base absorption and minimum/g factors in soft capsules, evaluation, quality control, stability testing and storage of capsule dosage forms. Microencapsulating: Types of microcapsules, importance on microencapsulation in pharmacy, microencapsulation by phase separation, coacervation, multi orifice, spray drying, spray congealing, polymerization complex emulsion, air suspension technique, coating pan and other techniques, evaluation of micro capsules. Tablets: Formulation of different types of tablets, granulation technology or large scale by various techniques, physics of tablets making, different types of tablet compression machinery and the equipment employed, evaluation of tablets, Coating of Tablets: Types of coating, film forming materials, formulation of coating solution, equipment for coating, coating process evaluation of coated tablets, Stability kinetics and quality assurance. Parenteral Products: Preformulation factors, routes of administration, water for injection, pyrogenicity, non-aqueous vehicles, isotonicity and methods of its

adjustment. Formulation details, containers and closures and selection. Prefilling treatment, washing of containers and closures, preparation of solution and suspensions, filling and closing of ampoules, vials, infusion fluids, lyophilization & preparation of sterile powders, equipment for large scale manufacture and evaluation of parenteral products. Aseptic Techniques: source of contamination and methods of prevention, design of aseptic area, laminar flow bench services and maintenance, Sterility testing of Pharmaceuticals. Surgical products: Definition, primary wound dressing, absorbents, surgical cotton, surgical gauzes etc. bandages, adhesive tape, protective cellulosic hemostatics, official dressings, absorbable and non absorbable sutures, ligatures and catguts, Medical prosthetics and organ replacement materials. Packaging of Pharmaceutical Products: Packaging components, types, specifications and methods of evaluation, stability aspects of packaging. Packaging equipments, factors influencing choice of containers, legal and other official requirements for containers, package testing. Controlled release (CR) and novel drug delivery systems: Principle, Advantages and Disadvantages, Classification and types of oral drug delivery system, transdermal and parenteral CR drug delivery agents.

LAB: Experiments to illustrate preparation, stabilization, physical and biological evaluation of pharmaceutical products like powders, capsules, tablets, parenteral, micro-capsules, surgical dressing etc., Evaluation of materials used in pharmaceutical packaging.

Books Recommended:

1. Aulton ME. "Pharmaceutics- The Science of Dosage Form Design", 1st edition, 1998, ELBS/Churchill Livingstone, New York.
2. Lachman L, Lieberman HA, Kanig JL." The Theory & Practice of Industrial Pharmacy", 3rd edition, 1991, Varghese Publishing House, Bombay.
3. Banker GS, Rhode CT. "Modern Pharmaceutics", 4th edition, Informa Healthcare, New York.
4. Allen LV, Popovich NG, Ansel HC", Ansel's pharmaceutical Dosage Forms & Drug Delivery Systems", 8th edition, 2005.
5. Lieberman HA, Lachman L, Sachwartz JB." Pharmaceutical Dosage Forms: Tablets", 2nd edition , 2005, Vol 1-3 Marcel Dekker, N.Y.
6. Bentia Simson, Microencapsulation, 2nd edition, 2007, Tylor's and Fransis

PHL 4405 Pharmaceutical Industrial Management (4-0-0) Credit 4

Concept of Management: Administrative Management, Entrepreneurship development, Operative Management (personnel, Materials, Production, Financial, Marketing, Time/space, margin/ Morale), Principles of Management, Principles of Accountancy, Ledger posting and book entries, preparation of trial balance, columns of a cash book, Bank reconciliation statement, rectification of errors, profits and loss account, balance sheet, purchase, keeping and pricing of stocks, treatment of cheques, bills of exchange, promissory notes of hundies, documentary bills, Principles of economics with special reference to the laws of demand and supply, demand schedule, demand curves, labor welfare, general principles of insurance & inland, foreign trade, procedure of exporting and importing goods, Pharmaceutical Marketing, Salesmanship and Market Research. Material Management: A brief exposure of basic principles of materials management major areas, scope, purchase, stores, inventory control and evaluation of materials management, Production Management: A brief exposure of the different aspects of Production Management- Visible & Invisible inputs, methodology of activities, performance evaluation techniques, process flow, process know- how, maintenance management.

Books Recommended:

1. Mohan S, Jai D." Drug Store and Business Management ", 1st edition, 1995, S.V Kar & Co, Jalandhar .
2. Singh S, Singh P." Drug Store and Business Management", 1st edition, 1995, S.Dinesh & Co.Circular Road Jalandhar.
3. Koontz & O'Donnel Principles of Management Tata Mc Graw Hill, Delhi.
4. G. Vidya Sagar, Pharamceutical Industrial Management, 2nd edition, 2005, Pharma Book Syndicate.
5. Dr S Arora: Pharmaceuticals-Issues for Industrial Management Frank brothers Publications, N Delhi

PHL 4407 Pharmacology III (4-0-0) Credit 4

PHP 2407 Pharmacology III (0-0-4) Credit 2

Drugs Acting on the Gastrointestinal Tract: Antacids, Anti Secretory and Anti- ulcer drugs, Laxatives and antidiarrhoeal drugs, Appetite Stimulants and Suppressants, Emetics and anti- emetics, Miscellaneous- Carminatives, demulcents, protectives, adsorbents, Astrigents, digestants, enzymes and mucolytics, Pharmacology of Endocrine System: Hypothalamic and pituitary hormones, Thyroid hormones and anti-thyroid drugs, parathormone, calcitonin, Vitamin D, Insulin, oral hypoglycaemic agents and Glucagon, ACTH and corticosteroids, Androgens and anabolic steroids, Estrogens, progesterone and oral contraceptives, Drugs acting on the uterus, Chemotherapy: General Principles of Chemotherapy, Sulfonamides and cotrimoxazole, Antibiotics- penicillins, cephalosporin's, chloramphenicol,

(Tetracycline and aminoglycosides), macrolides and miscellaneous antibiotics, Chemotherapy of tuberculosis, leprosy, fungal diseases, viral diseases, urinary tract infections and sexually transmitted diseases, Antimalarial drugs. Antiamoebic drugs, antihelminthic drugs, Chemotherapy of malignancy and immunosuppressive agents.

LAB: Experiments on Isolated Preparations: To calculate the pA₂ value of atropine using acetylcholine as an agonist on rat ileum preparation, the pA₂ value of mepyramine or chlorpheniramine using histamine as an agonist on guinea pig ileum, To estimate the strength of the test sample of agonist/ drug (e.g. Acetylcholine, Histamine, 5HT, Oxytocin etc.) using a suitable isolated muscle preparation employing matching bioassay, bracketing assay, 3 point and four point bioassay, Pharmacology of the Gastrointestinal Tract: To study the Anti- secretory and anti- ulcer activity using pylorus ligated rats, Toxicology of drugs: To study the drugs induced nephrotoxicity and hepatotoxicity.

Books Recommended:

1. Gilman, A.G., Goodman, L.S., Goodman and Gilman's The Pharmacological Basis of Therapeutics. 11th ed. 2006 Editors J.G. Hardman et al. Pergamon Press, New York
2. Tripathi K.D. Essential of Medical Pharmacology. 6th ed. 2008. Jaypee brother medical publisher. New Delhi
3. Katzung B.G. Basic & Clinical Pharmacology 4th ed. 2008 Churchill Livingstone New York
4. Rang M.P., Dale M.M. and Ritter, J.M. Pharmacology. 6th ed. 2007 Churchill Livingstone. London.
5. Harvey AR, Champ CP Pharmacology 3rd Ed 2006 Lippincott Williams & Wilkins Philadelphia
6. Kulkarni, S.K. Handbook of Experimental Pharmacology. 2nd ed. 1997 Vallabh Prakashan, Delhi

PHL 3409 Pharmaceutical Chemistry-VII (Medicinal Chemistry-II) (3-0-0) Credit 3

PHP 2409 Pharmaceutical Chemistry-VII (Medicinal Chemistry-II) (0-0-4) Credit 2

Introduction, Structure, Stereochemistry, Nomenclature, Synthesis of specified drugs (given in parenthesis), mode of action, Structure Activity Relationships (if any) uses and Physicochemical properties of the following classes of drugs: Steroids: Biosynthesis of Cholesterol; Estrogens (Oestradiol), Nonsteroidal estrogens (Stilboesterol), Antiestrogens, Progestogens, (progesterone from stigmasterol), Synthetic Progesterone (norethisterone), antiprogestogens, oral contraceptives, androgens (biosynthesis of testosterone and its synthesis from diosgenin), anabolic agents and adrenocorticoids (pathway for steroidogenesis), SAR of glucocorticoids, General Anaesthetics: Inhalational anaesthetics, Intravenous anaesthetics, Local Anaesthetics: Esters (Benzocaine), Amides (Lignocaine), Hypnotics and Sedatives: Barbiturates (Phenobarbitone); benzodiazepines (Nitrazepam), Anticonvulsants: Barbiturates; Hydantoin (Phenytoin); Oxazolidinediones (Troxidone); Benzodiazepines and Carbamazepine, Opioid Analgesics: Morphine and related drugs; Synthetic modifications of Morphine, totally synthetic analgesics; 6, 7-Benzomorphinan (Pentazocine), 4-phenylpiperidines (pethidine), Methadone and related derivatives; endogenous opioid peptides and opioid antagonists (Nalorphine), Antitussives: Centrally acting Antitussives, Opium alkaloids and related agents and Synthetic Antitussives, Peripherally acting antitussives and Expectorants, Central Nervous System Stimulants: Natural and Synthetic (Nikethamide); methylxanthines (Theophyllines) and Modified methylxanthines, Psychopharmacological Agents: Antipsychotic agents: Phenothiazines (chlorpromazine); butyrophenones and miscellaneous; Antidepressants: Tricyclic antidepressants (Amitriptyline), Atypical antidepressants; Monoamine oxidase inhibitors; Anxiolytics: Meprobamate and related drugs (Meprobamate); benzodiazepines (Diazepam), Diuretics: Carbonic anhydrase inhibitors (Acetazolamide); Thiazides and related drugs (Bendrofluazide); High ceiling diuretics (Furosemide), Aldosterone antagonists (spironolactone); other potassium sparing diuretics and osmotic diuretics, Cardiovascular agents: Cardiac glycosides; Antihypertensive agents; Antianginals and vasodilators; Antiarrhythmic drugs; Antihyperlipidemic drugs; Anticoagulant and platelet aggregation inhibitors (methylodopa, atenolol, procainamide, verapamil).

LAB: Workshop on stereomodel use of some selected drugs, Synthesis of selected drugs from the course content involving two or more steps and their spectral analysis, establishing the Pharmacopoeial standards of the drugs synthesized.

Books Recommended:

1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, Eleventh Edition, edited by J. H. Block and J. M. Beale Jr., Lippincott Williams & Wilkins, Philadelphia, 2004.
2. Pharmaceutical Chemicals in Perspective, B.G. Reuben and H.A. Wittcoff, John Wiley & Sons, New York, 1989.
3. Foye's, Principles of Medicinal Chemistry, Sixth Edition, Wolters Kluwer (India), Lea & Febiger, Philadelphia, USA, 2008.
4. Singh, H. and Kapoor, V.K. Medicinal and Pharmaceutical Chemistry, Second Edition Vallabh Prakashan, Delhi, 2005.

PHS 2411 Elective Project (0-0-4) Credit 2

B. Pharm. VIII Semester**PHL 4402 Pharmaceutics-IX (Dosage Form Design) (4-0-0) Credit 4****PHP 2402 Pharmaceutics-IX (Dosage Form Design) (0-0-4) Credit 2**

Preformulation studies: Study of physical properties of drugs like physical form, particle size, shape, density, wetting, dielectric constant. Solubility, dissolution and organoleptic property and their effect on formulation, stability and bioavailability, Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemization, polymerization etc., and their influence on formulation and stability of products, Study of pro-drugs in solving problems related to stability, bioavailability and elegance of formulation, Design, development and process validation: methods for pharmaceutical operations involved in the production of pharmaceutical products with special reference to tablets, suspensions, Stabilization and stability testing: protocol for various pharmaceutical products, Performance evaluation methods: In vitro dissolution studies for solid oral dosage forms, Federal perspectives on Immediate Release (IR) and Extended Release (ER) products, Brief Concepts of Bio pharmaceutics Classification Scheme Tinsky rule of five, in-vitro in-vivo correlation and bio-waiver, Important federal considerations for bio-availability and bio-equivalence studies for oral products; Statistical considerations including Crossover ANOVA, GMP and quality assurance, Quality audit, Design, development, production and evaluation of controlled released formulations.

LAB: Preformulation studies including drug-excipient compatibility studies, effect of stabilizers, preservatives etc. in dosage form design, Experiments demonstrating improvement in bioavailability through prodrug concept, Stability evaluation of various dosage forms and their expiration dating, Dissolution testing and data evaluation for oral solid dosage forms, Evaluation of Bioequivalence of some marketed products, In vivo bioavailability evaluation from plasma drug concentration and urinary excretion curves, Design, development and evaluation of controlled release formulations.

Books Recommended:

1. Aulton ME. "Pharmaceutics- the Science of Dosage Form Design", 1st edition, 1998, ELBS/Churchill Livingstone, New York.
2. Lachman L, Lieberman HA, Kanig JL." The Theory & Practice of Industrial Pharmacy", 3rd edition, 1991, Varghese Publishing House, Bombay.
3. Banker GS, Rhode CT. "Modern Pharmaceutics", 4th edition, Informa Healthcare, New York.
4. Lieberman HA, Lachman L, Sachwartz JB." Pharmaceutical Dosage Forms: Tablets", 2nd edition, 2005, Vol. 1-3 Marcel Dekker, N.Y.
5. Jain NK. "Controlled and novel drug delivery", 3rd edition, 2004, CBS Publishers & Distributors, New Delhi.

PHL 4404 Pharmaceutical Analysis-III (4-0-0) Credit 4**PHP 2404 Pharmaceutical Analysis-III (0-0-4) Credit 2**

Electromagnetic Radiations: Nature of Electromagnetic Radiations, the interaction between energy and matter. Ultraviolet and Visible Spectrophotometry: Electronic excitation, quantitative laws, deviations from Beer's law, graphical presentation of data, chromophores, photometric error, instrumentation (light sources, prism and grating monochromators, photoemissive and photomultiplier tubes), single and double beam instruments, spectrophotometric measurements, concentration and optimum absorbance value, applications. Fluorometric Analysis: Theory, quantitative description, experimental factors affecting fluorescence intensity, factors affecting I_0 and F directly, relationship of fluorescence to molecular structure, instrumentation (cells, light sources, wavelength selection, detectors), correction of spectra, pharmaceutical applications. Infrared Spectrophotometry: Theory, characteristic absorption bands of organic functional groups, interpretation of infrared absorption Spectra; Frequency range, bandwidth and scan speed, concentration range and absorbance value, preparation of sample, sample cell, IR instrumentation, (light sources, monochromator detectors), qualitative and quantitative applications in pharmaceutical analysis, analytical shortcomings. X-Ray Spectroscopy: An introduction to the theory of x-ray spectroscopy (Miller indices, Space lattice and unit cell, Bravais lattices). Interplanar spacing in crystal system. Diffraction of x-ray by crystals, Bragg's equation, powder method, x-ray diffraction pattern of cubic system (NaCl), applications in pharmaceutical analysis. Nuclear Magnetic Resonance Spectroscopy: An introduction to the theory of NMR, magnetic properties of the nuclei, nuclear magnetic moments, absorption of energy, chemical shift, shielding and deshielding, spin-spin coupling, NMR instrumentation, typical spectra, analytical application in pharmaceutical analysis. Mass Spectrometry: Instrumentation, Basic principle determination of the molecular formula, recognition of the molecular ion peak, fragmentation and analytical application in pharmaceutical analysis. Flame Photometry: Origin of spectra, atomization and ionization, instrumentation, nebuliser, mirrors, burners, slits, monochromator, detector, background emission, interferences,

qualitative & quantitative applications in pharmaceutical analysis. Atomic Absorption Spectroscopy: Theory of absorption of radiant energy by atoms, equipment, analytical applications. Polarimetry its Principles and Applications, Analytical method validation.

LAB: Quantitative estimation of at least ten formulations containing single drug or more than one drug, using instrumental techniques, Estimation of Na^+ , K^+ , Ca^{++} ions using flame photometry, IR of samples with different functional groups ($-\text{COOH}$, $-\text{COOR}$, $-\text{CONHR}$; $-\text{NH}_2\text{-OH}$, etc), Workshop to interpret UV, IR, NMR and Mass spectra.

Books Recommended:

1. L.G. Chatten, Pharmaceutical Chemistry, V 01. 1 and 2, Marcel Dekker, NY (Latest Edition).
2. A. H. Beckett and J. B. Stenlake, Practical Pharmaceutical Chemistry, Vol. 1 and 2, Athlone Press of the University of London (Latest Edition).
3. H. Willard, L.L., Marriott; Jr., J. A. Dean, Instrumental Methods of Analysis, Van Nostrand Reinhold, N.Y. (Latest Edition).
4. J. W. Robinson, Undergraduate Instrumental Analysis, Marcel and Dekker Inc., NY, 1970 (Latest Edition).
5. V. M. Parikh, Absorption Spectroscopy of Organic Molecules, Addison-Wesley Publishing Co., London, 1974 (Latest Edition).
6. D. A. Skoog, E. 1. Holler and T. A. Nieman, Principles of Instrumental Analysis, Saunders Golden Sunburst Series, Saunders College Publishing Harcourt Brace College Philadelphia, Fort Worth, Chicago (Latest Edition)

PHL 4406 Pharmaceutical Chemistry-VIII (Medicinal Chemistry-III) (4-0-0) Credit 4

PHP 2406 Pharmaceutical Chemistry-VIII (Medicinal Chemistry-III) (0-0-4) Credit 2

Drug Metabolism: Introduction, General pathways of drug metabolism: Phase I (Functionalization) and Phase II (Conjugation), Phase I: Oxidative reactions, Reductive reactions and Hydrolytic Reactions, Phase II: Glucuronic acid conjugation, Sulphate conjugation, Amino acid, conjugation, Glutathione conjugation, Acetyl conjugation and Methyl conjugation. Introduction, Structure, Stereochemistry, Nomenclature, Synthesis of specified drugs (given in parenthesis), mode of action, Structure Activity Relationships (if any) uses and physicochemical properties of the following classes of drugs: Antibacterials: Penicillins, Cephalosporins, Tetracyclines, Aminoglycosides, Polypeptides antibiotics, Chloramphenicol, Quinolones, Sulphonamides. Antimycobacterials: (p-Aminosalicylic acid, Thiacetazone, Isoniazid, Dapsone), Antimalarials: Quinine and analogues, 4-Aminoquinolines, 8-Aminoquinolines, 9-Aminoacridines, Biguanides (Chloroquine, Primaquine), Artemisinin & its derivatives, Antiviral agents: Introduction to DNA, RNA and retroviruses, Antiamoebic and antiprotozoal drugs: Emetine hydrochloride, quinoline derivatives, organometallic compounds, Metronidazole (Metronidazole, Diloxanide furoate), Anthelmintics: Drugs used in cestode infection, antifilarial agents (Thiabendazole, Niclosamide, Hexylresorcinol), Antifungal drugs: (Clotrimazole, Ketoconazole), Antineoplastic agents: Alkylating agents, Antimetabolites, Antitumor alkaloids, Hormones agonist and antagonists (Tamoxifen, Thiotepa, Chlorambucil), Antibiotics, Vinca Alkaloids and Paclitaxel, Hormones: Thyroid and Antithyroid Drugs; Insulin & Oral hypoglycemic agents, Diagnostic Agents and Organic Pharmaceutical Aids

LAB: Experiments designed on drug metabolism: Preparation of S9 and microsomes from tissue homogenates and standardization of protein, Effect of Phenobarbital pretreatment on microsomal cytochrome p-450, cytochrome b5, and NADPH-Cytochrome C-reductase and comparison of microsomes from control, Determination of microsomal aminopyrine demethylase and p-nitroanisole demethylase activities, Determination of microsomal azo- and nitroreductase activities, Synthesis of selected drugs, Establishing the pharmacopoeal standards and spectral studies

Books Recommended:

1. Singh & Kapoor. Medicinal & Pharmaceutical chemistry. 1st edition, 2001. Vallabh publications, Delhi.
2. Wilson & Gisvolds. Text book of Organic Medicinal & Pharmaceutical Chemistry. 11th edition, 1998 Lippincott Williams & Wilkins, London.
3. Lemke, Williams, Roche & Zito. Foye's Principles of Medicinal Chemistry. 6th edition, 2008. Lippincott Williams & Wilkins, London.
4. Nogrady & Weaver. Medicinal Chemistry, 3rd edition, 2005. Oxford university, Newyork.
5. Wermuth. The Practice of Medicinal Chemistry, 2nd edition, 2004. Elsevier India Pvt Ltd, New Delhi.

PHL 3408 Pharmacognosy-VI (3-0-0) Credit 3

PHP 2408 Pharmacognosy-VI (0-0-4) Credit 2

World-wide trade in medicinal plants and derived products with special reference to diosgenin (dioscorea) taxol (Taxus spp) digitalis, tropane alkaloid containing plants, papain, Cinchona, Ipecac, Liquorice, Ginseng, Aloe, Valerian, Rauwolfia and plants containing laxatives, A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India. Utilization and production of phytoconstituents such as quinine, calcium

sennosides, podophyllotoxin, diosgenin, solasodine, and tropane alkaloids, Utilization of aromatic plants and derived products with special reference to sandalwood oil, mentha oil, lemon grass oil, vetiver oil, geranium oil and eucalyptus oil, Historical development of plant tissue culture, types of cultures, nutritional requirements, growth and their maintenance, Applications of plant tissue culture in pharmacognosy. Chemotaxonomy of medicinal plants. Marine pharmacognosy, novel medicinal agents from marine sources, Natural allergens and photosensitizing agents and fungal toxins, Herbs and health foods and nutraceuticals and introduction to registration aspects of herbal products for marketing. Agencies controlling regulatory aspects for herbal products at national and international level (WHO, EMEA etc), Herbal cosmetics, Stability testing of herbal products.

LAB: Isolation of some selected phytoconstituents studied in theory, Extraction of volatile oils and their chromatographic profiles, some experiments in plant tissue culture.

Books Recommended:

1. Atal, C.K. and Kapur, B.M. Cultivation & Utilization of Medicinal Plants, RRL Jammu.
2. Kalia, A.N. Textbook of Industrial Pharmacognosy, CBS Publishers & Distributors, New Delhi.
3. Ansari, S.H. Essentials of Pharmacognosy. Third Edition 2009, Birla Publication Pvt. Ltd., Delhi.
4. Remington. The Science and Practice of Pharmacy, Vol. I & II, Mack Publishing Company, Pennsylvania.
5. Wagner, H. and Bladt, S. Plant Drug Analysis- A Thin Layer Chromatography Atlas, Second Edition, Springer India Pvt.
6. www.ayush.com.

PHL 4410 Pharmacology-IV (Clinical Pharm. & Drug Interactions) (4-0-0) Credit 4

Introduction to Clinical Pharmacy, Basic Concepts of Pharmacotherapy: Clinical Pharmacokinetics and individualization of Drug Therapy, Drug Delivery systems and their Biopharmaceutical and Therapeutic Considerations, Drug use during Infancy and in the Elderly (Pediatrics and Geriatrics), Drug use during pregnancy, Drug induced Diseases, The Basics of Drug Interactions, General Principles of Clinical Toxicology, Interpretation of Clinical Laboratory Tests, Important Disorders of Organ Systems and their Management: Cardiovascular Disorders-Hypertension, Congestive Heart Failure, Angina, Acute Myocardial Infarction, Cardiac arrhythmias, CNS Disorders: Epilepsy, Parkinsonism, Schizophrenia, Depression, Alzheimer's disease Respiratory Disease-Asthma, Gastrointestinal Disorders- Peptic ulcer, Ulcerative colitis, Hepatitis, obesity, Endocrine Disorders-Diabetes mellitus and Thyroid Disorders, erectile dysfunction, Infectious Diseases-Tuberculosis, Urinary Tract Infection, Enteric Infections, Upper Respiratory Infections – malaria, amebiosis, HIV, Hematopoietic Disorders-Anemias, Joint and Connective Tissue Disorders- rheumatic disorder such as rheumatoid arthritis, Juvenile rheumatoid arthritis, ankylosing, spondylitis Gout and Hyperuricemia, Neoplastic Diseases-Acute Leukemia, Hodgkin's disease, Therapeutic Drug Monitoring, Concept of Essential Drugs and Rational Drug use. Principles of Toxicology: Definition of poison, general principles of treatment of poisoning with particular reference to barbiturates, opioids, organophosphorous and atropine poisoning, Heavy metals and heavy metal antagonists, Organ system toxicology of CNS, Liver, reproductive, respiratory and the formed elements of the bloods.

Books Recommended

1. Laurence, D.R. & Bennet, P.N. Clinical Pharmacology, 9th edn. 2006 Churchill Livingstone New York
2. Graham Smith D G. Aronson J K Oxford text book of clinical pharmacology and drug therapy. 1984 Oxford University press USA
3. Remington's The Science and Practice of Pharmacy, Mack Publishing Co. Pennsylvania.
4. Rowland, M. and Tozer, T.N. Clinical Pharmacokinetics Lea and Febiger, N.Y.
5. Winter, M.E. Basic Clinical Pharmacokinetics, Applied Therapeutics Inc., San Francisco.

PHS 2412 Dissertation on the Project (0-0-4) Credit 2

10. Appendix A: Course Code Scheme

Sample Course Code						
A	M	L	3	2	0	3

First two letters would indicate the academic Unit offering the course

Third letter would indicate the type of Course

First Number = Credits of the course = **Round up (Lecture hours per wk * 1 + Tutorial Hours per wk * 0.5 + Lab hours per wk * 0.5)**

Second Number = Year of Program

Last Two numbers = Sequencing of course

Allotment of first two letters	
AM	Maths
PY	Physics
CH	Chemistry
GE	General Education
CL	Languages
CS	Computer Science
EC	Electronics
EE	Electrical
ME	Mechanical
CE	Civil
CA	Computer Applications
BS	Business Studies
AR	Architecture
ED	Education
PH	Pharmacy
PC	M.Pharm. Pharmaceutics
PT	M.Pharm. Pharmaceutical Technology
PG	M.Pharm. Pharmacology
AS	Applied Science
PE	Physical Education
COMP	Courses of GBC(Canada)
HS	Health Sciences
JM	Journalism & Mass Communication
HM	Hotel management

Third letter	
L	Course with only theory component
P	Course with only Lab component
T	Training, Dissertation
S	Self Study, Project, Seminar
W	Workshop course

First numeral	
1	1 credit course
2	1.5 or 2 credit course
3	2.5 or 3 credit course
4	3.5 or 4 credit course
5	4.5 or 5 credit course
6	5.5 or 6 credit course
7	6.5 or 7 credit course

8	7.5 or 8 Credit Course
9	8.5 or 9 or more credit course

Second Numeral (this number indicates the incremental year of study after 12 th class)	
0	For courses are after 10 th
1	Year 1
2	Year 2
3	Year 3
4	Year 4
5	Year 5
6	Year 6
7	Year 7

Third and Fourth Numerals (Sequencing of Course)	
01	Course Number 1
02	Course Number 2
03	Course Number 3
04	Course Number 4
05	Course Number 5
06	Course Number 6
07	Course Number 7



11. Appendix B: Calculation of CGPA

The CGPA (calculated on a 10 point scale) would be used to describe the overall performance of a student (from the semester of admission till the point of reckoning) in all courses for which LETTER GRADES will be awarded. GPA will indicate the performance of student for any particular semester. Formulas for calculation of GPA and CGPA has been provided as below:

$$GPA_i = \frac{\sum_{j=1}^n C_{ij} G_j}{\sum_{j=1}^n C_{ij}}$$

$$CGPA = \frac{\sum_{i=1}^N \left(GPA_i * \sum_{j=1}^n C_{ij} \right)}{\sum_{i=1}^N \left(\sum_{j=1}^n C_{ij} \right)}$$

Where n = number of subjects in the semester; N = number of semesters; GPA_i = GPA for the ith semester; C_{ij} = number of credits for the jth course in ith semester; and G_j = Grade point corresponding to the grade obtained in the jth course. Table below shows the grade point for every valid grade that may be awarded to a student pursuing a particular course:

Marks Range	Grade	Qualitative meaning	Grade point
90 - 100	A+	Distinguished	10
85 -89	A	Excellent	9
80 - 84	A-		8.5
75 – 79	B+	Very Good	8
70 – 74	B		7.5
65 – 69	B-	Good	7
60 - 64	C+		6.5
55 -59	C	Fair	6
50 – 54	C-		5.5
45 – 49	D+	Satisfactory	5
40 – 44	D		4.5
0 – 39	E	Exposed	0
	I	Incomplete	

‘I’ grade would be awarded to those students, who due to some reason or the other have not been able to appear in certain required number of evaluation components conducted for a course. Later ‘I’ grade would be changed to a relevant grade, once a student has fulfilled the requirement of appearing in certain number of evaluation components for a course.

Example to Understand the Calculation of GPA

Suppose a student is registered in four courses ‘W’, ‘X’, ‘Y’ and ‘Z’ in a particular semester as mentioned below in the Column - I of the table. Column - II in the table below depicts the number of credits, which those courses carried. At the end of the semester, student was awarded with the grades as mentioned in Column – III in the table given below. Column – IV indicates the corresponding grade weight. Column – V and Column – VI indicate essentially the Credit value and Grade Points for every course completed by a student in that particular semester.

Courses in which student registered (Column – I)	Credits (Column – II)	Letter Grade Column - III	Grade Value (Column – IV)	Credit Value (Column – V)	Grade Points (Column – VI)
Course W	3	B-	6	3 x 6	18



Course X	3	A-	8	3 x 8	24
Course Y	3	A+	10	3 x 10	30
Course Z	2	A+	10	2 x 10	20
Total	11			Total	92

Thus, the total GPA of the student would be =

$$GPA = \frac{\text{Total grade pts.}}{\text{Total no. of credits}} = \frac{92}{11} = 8.36$$

Suppose the GPA of the student in two successive semesters is 7.0 and 8.0 with respective course credits being 12 and 11, then the

$$CGPA = \frac{7 \times 12 + 8 \times 11}{12 + 11} = \frac{84 + 88}{23} = 7.48$$