



Bachelor of Pharmaceutical Sciences
(B. Pharm.)

Detail Syllabus

THE SCHOOL OF PHARMACEUTICAL AND BIOMEDICAL SCIENCES
FACULTY OF SCIENCE AND TECHNOLOGY
POKHARA UNIVERSITY
www.pu.edu.np

BACHELOR OF PHARMACEUTICAL SCIENCES (B. PHARM.) PROGRAM

GOAL AND FOCUS

The School of Pharmaceutical and Biomedical Sciences is being established at the beginning of this century under Pokhara University, Pokhara by the common efforts of educators, parents, students, and benefactors it aims for a new standard in pharmaceutical education to meet the challenges of health of the 21st century. The School is expecting to produce highly qualified graduates and subsequently to promote research excellence in a free and scholastic environment.

The University has prepared its curriculum emphasizing on

- Himalayan medicinal resources
- Clinical pharmacy education.

The School of Pharmaceutical and biomedical Sciences has but one goal – to make students able to appreciate the sanctity of life and flush them with a pioneering spirit that enables them to make a valuable contribution to medical treatment and people's health.

OBJECTIVES

The course of Pharmaceutical Sciences for B. Pharm. is designed to achieve the following objectives to:

- provide adequate educational background for rewarding careers in pharmacy profession.
- study and strengthen the existing pharmacy practices in the private and public sector organizations through continuing education and training programs.
- assist pharmaceutical and related organizations in solving their problems by providing consultancy services.
- contribute to pharmacy literature relevant to Nepal through research and publications.

CAREER OPPORTUNITY

The role of the Pharmacists is expanding day by day. On the other hand, the number of Pharmacists in Nepal is quite limited. Therefore, there is a great employment opportunity for the Pharmacists within Nepal or in foreign countries. In general, a Pharmacist can choose following area to build the career.

- University (Education and Research)
- Pharmaceutical Industry
- Pharmacy (retail pharmacy)
- Hospital
- Governmental Drug Administration
- Drug Research Laboratory
- Health Research Council
- Adverse Drug Reaction Monitoring Service
- Health Food Development
- Natural Medicine Resource Development

AN INTRODUCTION TO B. PHARM. PROGRAM

A. GENERAL

1. Title

The title of the program is Bachelor of Pharmaceutical Sciences (B. Pharm.)

2. Objective

The objective of the B. Pharm. program is to produce a highly qualified pharmacist.

3. Location

Presently, all classes will be held in The School of Pharmaceutical and Biomedical Sciences, Pokhara University located at Simalchaur, Pokhara.

4. Course Structure

- The B. Pharm. course comprises of 19 credit hours in first semester, 15 credit hours in last semester and 22 credit hours in all other semesters with the total of 166 credit hours spreading over eight semesters.
- Three credit hours of theory is equivalent to 45 hours lecture in one semester. One credit of practical involves at least three hours practical work per week.
- All theory courses will be of three credit hours and all practical and seminars will be of one credit hour. The pharmacy practice will be of three credit hours. Project works will be of ten credit hours.
- An average involvement of a student in University will be of 6 h/day, i. e. 36 h/week (Sunday to Friday). Approximate active weeks will be of 16 weeks/semester and therefore, in total, the student will be engaged more than 540 h/semester.

- Each theory class will be of 55 minutes and after two continuous theory classes there will be a break of 15 minutes. Each practical and seminar classes will be of minimum three hours.

- Subject Code will be as follow:

0	PHT	=	Pharmaceutics, related subjects and Pharmacy Practice
1	PHL	=	Pharmacology
2	BCM	=	Biochemistry
3	APL	=	Anatomy and Physiology
4	CBL	=	Molecular Cell Biology
5	MBL	=	Microbiology
6	IML	=	Immunology
7	PHC	=	Pharmaceutical Chemistry and Medicinal Chemistry
8	PHG	=	Pharmacognosy
9	Others	=	Mathematics (MTH),English (ENG), Computer Science (CSC),Research (RES) and Project Work (PRW)

5. Course Coding

Each course is identified by three capital letters followed by three digits. Three letters indicate the subject area (e.g.,PHT for pharmaceutics, MTH for mathematics etc). The first digit of each number indicates the academic year of the course (1 for first year, 2 for second year and so on).The second digit indicates subject (*see* subject code in structure), and the third digit indicates the sequence.

6. Normal and Maximum Duration of Stay in the University

The normal duration for completing the B. Pharm. Course is four years. In exceptional case, however, the student is allowed normal duration plus two years to complete the course. If a student is unable to complete the course within six years from the time of admission, the University registration is annulled.

7. Academic Schedule

The academic session consists of two semesters per year. Generally the Fall Semester (September - February) starts in September and the Spring Semester (February - August) begins in February, however it may differ slightly in any particular year.

8. Medium of Teaching and Examination

The medium of instruction and examination for B. Pharm. program will be English.

9. Special Seminar

Scientists/professionals of national or international repute will be invited to deliver special seminar.

10. Other

All other rules and regulations will be followed as already established by Pokhara University.

B. ADMISSION AND EXAMINATION

1. Entry Requirement for New Student

The entry requirement for a new student in B. Pharm. will be Intermediate in Science (I. Sc.) or Higher Secondary level (10+2, Science Stream) or Proficiency Certificate Level (PCL, Science), or equivalent as recognized by Pokhara University with more than 50% marks. Besides the basic academic requirement, an entrance examination will be held for all applicants.

2. Admission Procedure

The application form and the information can be obtained on request from The School of Pharmaceutical and Biomedical Sciences, Pokhara University, Pokhara or Contact Office of Pokhara University, Kathmandu. Only the eligible candidates will be allowed to take part in the entrance test.

The subjects in the entrance test will be Chemistry, Biology, Mathematics, and English according to the syllabus of grade 11 and 12 levels. The University may also hold interviews for the candidates before their final selection for admission. The candidates will be admitted on merit basis. Eligible foreign national students may be admitted against limited seats on the basis of an interview.

The candidates, who are given provisional admission under special condition, are required to submit all necessary documents within a month of the beginning of regular classes. Otherwise, the admission will be annulled.

3. Student Evaluation

The student's academic performance during a semester will be evaluated internally (sessional work) and externally (the final examination). The sessional work examination will be evaluated by the teaching Faculty and it will be of 50% weight. The remaining 50% will be the final examination, conducted by University.

In the Practical courses, no final examination will be conducted and the sessional marks shall be awarded on the basis of internal assessment.

To pass a particular course, a student must obtain a minimum of D grade in sessional work (average of internal assessments) and the final examination, separately.

4. Attendance Requirement

The students must attend every lecture, tutorial, seminar and practical classes. However, to accommodate for sickness and other contingencies, the attendance requirement shall be a minimum of 80% of the classes in any particular subject, otherwise s/he shall not be allowed to take the final examination in that subject. If a student is continuously absent in the class for more than four weeks without notifying the authorities, his/her name will be removed from the school roll.

5. Course Registration

The academic record of a student shall be maintained in terms of the courses for which s/he registers in any semester, and the grades s/he obtains in those courses. Registration for courses is done at the beginning of each semester. Since registration is a very important procedural part of the credit system, it is absolutely essential that all students present themselves at the school. In case of illness or any exceptional circumstance during the registration period, the student must inform the University authority. Registration absentia may be allowed only in rare cases, at the discretion of the authorized person. However, the student's nominee cannot register for courses and will only be allowed to complete other formalities.

Generally in a particular semester or year only those courses would be offered for registration which are mentioned in the syllabus, however their sequence may be interchanged if necessary.

6. Repeating a Course

Since passing of all courses individually is a degree requirement, the student must retake the failing core course when offered and must successfully complete the course. Retaking a course in which a student has earned a D grade is optional. Student can retake a course when one receives GPA less than 2.0. The grade earned on the retake will be substituted for the grade earned previously.

7. Transfer of Credit Hours

A maximum up to 25% of the total credit hours of course completed in an equivalent program of a recognized institution may be transferred/waived for credit on the recommendation of the head of the faculty. For transfer of credit, a student must have received a grade of B or better in respective course. Courses taken earlier than five years from the time of transfer may not be accepted for transfer of credit. However, a student transferring from one program to another program of Pokhara University may receive a credit transfer of all the compatible courses completed with at least grade C.

The concerned Subject Committee of the University will make an evaluation of the applicant for transfer of credit. The awarding of transferred credit will be based on the applicant's score in the University, which s/he has attended previously.

8. Final Examination

University conducts final examination at the end of each semester. The procedure of final examination conduction will be as per the examination rules of the University.

9. Unsatisfactory Results

Students may apply for retotalling or rechecking of their grades as per University rule, upon payment of prescribed fee.

C. Grading System

The grades (marks) awarded to student in a course is based on his/her consolidated performance in sessional and final examinations. The letter grade in any particular subject is an indication of a student's relative performance in that course.

The pattern of grading will be as follows:

Letter	Grade	Grade point description
A	4.0	Excellent
A-	3.7	
B+	3.3	Good
B	3.0	
B-	2.7	
C+	2.3	Satisfactory
C	2.0	
C-	1.7	
D+	1.3	
D	1.0	Minimum requirement
F	0	Failing

In unusual circumstances, the student may be awarded an incomplete grade of "I". If all the requirements are not completed within the following semester, the grade of "I" will be automatically converted to an "F". A student receiving an "I" grade does not need to register for that subject in the following semester to complete the required works.

The performance of a student in a semester will be evaluated in terms of the semester grade point average (SGPA). The student's final grade will be calculated on cumulative grade point average (CGPA).

SGPA = Total honor points earned in a semester/total number of credits registered in a semester. CGPA = Total honor points earned/total number of credits completed.

D. DIVISION EQUIVALENCE

In Pokhara University, CGPA 2.5 or more and 3.0 or more are considered as Second and First divisions, respectively.

E. DISMISSAL FROM THE PROGRAM

A student is normally expected to maintain a CGPA of 2.0. A student failing to maintain a satisfactory academic standard shall be dismissed from the program. In case a student gets less than 2.0 SGPA then in marginal cases only the Dean or the faculty can allow the student to continue his/her studies on the recommendation of program director or the subject committee.

F. Award of Degree

On completion of total 166 credits with CGPA of 2.0 or better including in theory, practical, seminar, field work, compulsory training in industry, hospital and retail pharmacy and project work, the student will be awarded a degree of Bachelor of Pharmaceutical Sciences (B.Pharm.)

G. DEGREE WITH DISTINCTION

To obtain a degree with distinction, a student must obtain CGPA 3.6 or better

H. DEAN'S LIST

The Dean's list recognizes outstanding performances of academic excellence by students. To qualify, a student must obtain a CGPA of 3.7 or better.

Note: The provisions of this document are not to be regarded as a binding contract between the University and the students. The University reserves the right to change any provisions or requirements contained in this document at any time, without pre-notification, within the students' term of residence.

First Year
First Semester

CURRICULUM STRUCTURE

FIRST YEAR

FIRST SEMESTER

Code	Description	Credit hours	Pre-requisite course	Core Course
PHT 101	Pharmaceutics I (Fundamentals of Pharmacy)	3	.....	☼
PHC 171	Pharmaceutical Chemistry I (General Chemistry)	3	.....
PHC 172	Pharmaceutical Chemistry II (Stereochemistry & Reaction Mechanism)	3	.....
CSC 191	Computer Science (Introductory)	3	.....
MTH 192	Mathematics (Algebra, Trigonometry, Calculus)	3	.....
ENG 193	Communication Skill (Technical English)	3	.....
LAB-1	Pharmaceutical Laboratory 1	1	.....
TOTAL		19		

PHT 101 (Credit hours 3)**Pharmaceutics I (Fundamentals of Pharmacy)**

B. Pharm., First Year, First Semester

Course Objectives:

The students will become familiar with the commonly used terminology in pharmacy practice, which shall provide abroad view of pharmacy education.

Unit	Course Description	Hr	Details
1	Drugs Drug definition, Doses, Ways of application, Side effects, Bioavailability, Regulation	10	<ul style="list-style-type: none">• Drug definition: Pharmaceutical terminologies including WHO definition of drugs- 1hr• Doses: Introduction to different dosage forms i.e. solid, liquids, semisolids & gases – 4hr• Ways of application: Introduction to various routes of drug administration -2hr• Definition & concept of side effects, adverse drug reactions and bioavailability- 2hr• Regulation: Introduction to drug regulation & regulatory authorities- 1hr
2	History of Pharmacy History, Traditional pharmacy, Western pharmacy, Oriental pharmacy	3	<ul style="list-style-type: none">• National and international history of pharmacy-2hrs• Introduction to concept of Traditional pharmacy, Western pharmacy, Oriental pharmacy-1hr
3	Modern Pharmacy Computer in pharmacy, Patient follow-up, Regulation, Prescription drugs, Over-The-Counter (OTC) drugs, Patient and Society education	5	<ul style="list-style-type: none">• Prescriptive and non-prescriptive(OTC) drugs -1hr• Regulation (legal provisions) of prescriptive and non-prescriptive drugs-1hr• Patient follow-up: Need of follow-up of medicine users (pharmacological and non-pharmacological)-1hr• Patient and society education: Role of pharmacist on patient and society education-1hr• Use of computer in pharmacy-1hr
4	Drug Discovery and Development Search for new drugs, New substances versus new method of application, Novel drug delivery system, Patent regulation, Marketing, Food and Drug Administration (FDA), Traditional	8	<ul style="list-style-type: none">• Search of new drug: Identification, isolation, characterization, separation, standardization, synthesis, quality control & formulation or development of a new drug molecule with example-2hrs• New substances versus new method of application: Concept & example of new

	medicine		<p>drug delivery-2hr</p> <ul style="list-style-type: none"> • Patent regulation: Concept and importance in relation to pharmacy & marketing (sales and marketing of patent drugs). Introduction to FDA and their role-2hrs • Traditional medicine: Meaning of traditional medicine, modern medicine vs traditional medicine. Examples (Digitalis, Rawolfia)of modern medicine derived from traditional medicine. -2hr
5	Production of Drug Pharmacy-Galenic drugs, Industry, Good manufacturing practices (GMP) and Good laboratory practices (GLP), Regulation, Quality control, Packaging, Advertisement	6	<ul style="list-style-type: none"> • Galenic drugs: Methods of extraction processes (maceration, decoction, extraction, distillation etc) -2hrs • GMP & GLP: Concept and components-2hr • Regulation: Provisions of regulation of industries in Nepal , Provision of advertisement of drugs in Nepal-1hr • Industry: Brief introduction about various units in a pharmaceutical industry and their functions (production, quality control, packaging, quality assurance, store)-1hrs
6	Role of Pharmacists Retail pharmacy in society, Clinical pharmacy, Industrial pharmacy, Drug regulation, Environment protection, Role in Nepalese society	6	<ul style="list-style-type: none"> • Role of retail pharmacist in the society in Nepalese context.-2hrs • Role of clinical pharmacist in management of a disease and Nepalese context-1hr • Role of industrial pharmacist in manufacturing of a drug-1hr • Role of pharmacist in environmental protection (as community, hospital and production pharmacist)-1hr • Role of pharmacist in drug regulation (role in DDA)-1hr
7	Pharmacopoeia Pharmacopoeia, Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia, European Pharmacopoeia, Japanese Pharmacopoeia, Martindale Pharmacopoeia, Nepalese Formulary, Essential Drug List of Nepal, Essential Drug List of WHO, Merck Index	4	<ul style="list-style-type: none"> • Pharmacopoeia & other official references: Content (source for) and technique of use as resource of Pharmacopoeia, Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia, European Pharmacopoeia, Japanese Pharmacopoeia, Martindale Pharmacopoeia, Nepalese Formulary, Essential Drug List of Nepal, Essential Drug List of WHO, Merck Index- 4 hrs •

8	Research and Literature in Pharmacy Research in pharmacy, Original research articles, Review, Books, Journals, Role of seminar and conference, Role of literature on research	3	<ul style="list-style-type: none"> • Research in pharmacy: Concept of research, areas & types of resources in pharmacy (community based, hospital based, laboratory based)-1hr • Introduction to original research, articles, reviews, books and journals-1hr • Role of seminar, conference & literature on research
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Reference Books:

1. J. Winfield and R. M. E. Richards: *Pharmaceutical Practice* (2nd Ed.) 1999, Churchill Livingstone, New Delhi.
2. Howard C. Ancel, Nicholas G. Popovich and Loyd V. Allen: *Pharmaceutical Dosage Forms and Drug Delivery System* (6th Ed.) 1995, B. I. Waterly Pvt., Ltd., New Delhi.
3. Michael E. Aulton (Ed.): *Pharmaceutics, The Science of Dosage Form Design*, 1999, Churchill Livingstone, Edinburgh.
4. E. A. Rowlinson (Ed.): *Bentley's The Textbook of Pharmaceutics* (8th Ed.) 2001, Bailliere Tindall, London.

PHC 171 (Credit hours 3)**Pharmaceutical Chemistry I (General Chemistry)
(Fundamentals and Analytical Technique)****B. Pharm., First Year, First Semester****Course Objectives:***This course is designed to understand fundamentals of chemistry and principles of qualitative and quantitative analysis*

Unit	Course Description	Hrs.	Details
1	Atomic Structure Bohr's theory and refinements, Wave mechanical model of the atom, Matter wave, de Broglie's equation, Heisenberg's uncertainty principle, Shapes of s, p, d orbital's, Quantum numbers and their significance, Energy level diagram of hydrogen atom only.	8	With postulates & limitations. Specific Text book for unit 1: Concise Inorganic Chemistry by J. D. Lee
2	Chemical Bonding General characteristics of covalent bond, electrovalent bond, coordinate covalent bond, hydrogen bond, and Van der Waals force and their biological significance, Hybridization, Inductive effective, Electrometric effect, Mesomerism, Resonance, Hyperconjugation.	6	Definition with examples, general properties including nature, state, solubility, conductivity, isomerism, mp, bp, Discussion of co-ordinate covalent bond with reference to H_3O^+ , NH_4^+ , CH_3NO_2 $SP(C_2H_2)$, $SP_2(C_2H_4)$, $Sp_3(CH_4)$, $SP_3d(PCl_5)$, , structure of water, NH_3 , CH_4 , C_2H_4 , C_2H_2 , C_6H_6 (shape, bond angle, orbital picture according to hybridization theory) Specific Text book for bonding and hybridization topics- unit 2: Essential of Physical Chemistry by B.S.Bahl From Inductive effect to Hyperconjugation, follow the chapter in Basic Organic Chemistry by B.S. Bahl
3	Periodic Table Periodicity of element, s, p, d, f blocks, Long form of periodic table, Discussion of properties (atomic, ionic and covalent radii, ionization potential, screening or shielding effect, electronegativity, electron affinity)	6	Factors affecting IP, EN, EA and their periodic trend

4	Nuclear Chemistry Composition of nucleus (nuclear stability), Binding energy, Radioactivity, Half-life determination, Nuclear reaction	6	Different theories (At least three), & calculation, mass defects and its mathematical relation with binding energy Fission and Fusion nuclear reaction and their comparison Application of radioactivity, Specific Text book unit 4: Essential of Physical Chemistry by B.S.Bahl
5	Coordination Chemistry Werner's theory, Nomenclature, Isomerism, Valence bond theory, Crystal field theory	5	Postulates and limitation of each theory IUPAC Naming of complex compounds Specific Text book for unit 5: concise inorganic chemistry by J.D. Lee
6	Principles of Qualitative and Quantitative Analysis Solubility product, Common ion effect, Their application in group separation, Principles of gravimetric and volumetric analysis	14	Define and classify in brief about Quali and Quanti analysis from Book of Vogel From Solubility to group separation-follow specifically from Essential of Physical Chemistry by B.S. Bahl Brief introduction about Gravi and volumetric analysis. Under Volumetric analysis, discuss briefly about different types of titration (acid-base, redox, complexometric or ppt)

Reference Books:

1. Samuel H. Maron and Carl F. Prutton: *Principles of Physical Chemistry* (4th Ed.) 1972, Oxford and IBM Publishing Co. Pvt. Ltd., New Delhi.
2. B. S. Bahl, G. D. Tuli and Arun Bahl: *Essentials of Physical Chemistry* (24th Ed.) 2000, S. Chand and Company Ltd., New Delhi.
3. F. Albert Cotton, Geoffrey Wilkinson and Paul L. Gaus: *Basic Inorganic Chemistry* (3rd Ed.) 2001, JohnWiley and Sons Inc., New York.
4. Satya Prakash, G. D. Tuli, S. K. Basu, and R. D. Madan: *Advanced Inorganic Chemistry* (18th Ed.) Vol I, 2000, S. Chand and Company Ltd., New Delhi.
5. G. Svehla: *Vogel's Qualitative Inorganic Analysis* (7th Ed.) 1998, Longman Group Limited., New York.
6. G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney *Vogel's Quantitative Chemical Analysis* (5th Ed.) 1999, Addison Wesley Longman Inc., New York.

PHC 172 (Credit hours 3)

Pharmaceutical Chemistry II
(Stereochemistry and Reaction Mechanism)
B. Pharm., First Year, First Semester

Course Objectives:

This course will provide the fundamental knowledge on the structure and chemical reaction of organic molecule or drugs.

Unit	Course Description	Hrs	Details
1	1. Structure and Nomenclature Organic Compounds Atomic structure, Orbitals, Electron configuration, Covalent bond, Valence bond Theory, Molecular orbital theory, Hybridization of carbon (sp^3 , sp^2 , sp), oxygen, and nitrogen, Drawing of chemical structure, Molecular model, Functional group, Classification of organic compounds, Nomenclature (Classical, IUPAC)	7	Atomic structure:- Orbitals-s,p-f orbital Electronic configuration- 1-40 elements Covalent bonds-Valence bond theory, molecular orbital theory[N_2 , O_2] Hybridization of methane- $[sp^3]$, Ethene $[sp^2]$, ethyne $[sp]$ hybridization of oxygen- $[H_2O]$, nitrogen $[NH_3]$ Drawing of chemical structure- Lewis structure, Condense structure, Skeleton structure, Displayed structure Molecular model-Use ball and stick model Functional group- Classification of organic compounds- Nomenclature [classical, IUPAC] IUPAC system for each functional group IUPAC system for polyfunctional group
2	Stereochemistry Stereochemistry and stereoisomerism, Optical activity, Polarimeter, Specific rotation, Enantiomerism and Tetrahedral carbon, Enantiomerism and Optical activity, Prediction of enantiomerism (chirality), Chiral center, Racemic modification, Configuration, Specification of configurations (R and S), Sequence rule,	13	As it is (followed from-Mc Murry book)

	Diastereomers, Epimers, Geometrical isomerism, <i>E</i> and <i>Z</i> -configurations		
3	Conformational Analysis Conformation in open chain system, Conformation in six membered rings, Conformation in six membered rings containing heteroatoms, Conformation in other rings, conformation and physical properties, Conformational effects on stability and reactivity	8	As it is (followed from –Morrison and Boyd)
4	Reaction Mechanism Types of mechanism, Types of reaction, Thermodynamic and Kinetic requirements for reaction, Kinetic and Thermodynamic control, the Hammond postulate, Microscopic reversibility	7	As it is (followed from Jerry march)
5	Methods for Determining Mechanism Identification of products, Determination of the presence of intermediate, Study of catalysis, Isotope labeling, Stereochemical evidence, Rate expression for the first and second order reaction, Isotope effect	5	As it is (followed from Jerry march)
6	Reactive Intermediates Stability, Structure, Generation, and Fate of Carbocation, Carbanion, Free radical, Carbene, Nitrene, and Benzyne, Nonclassical carbonium ion, Neighbouring group participation by pi- and sigma-bonds, Aromaticity and Antiaromaticity	5	As it is (Follower from Jerry march)

Reference Books:

1. John McMurry: *Organic Chemistry* (5th Ed.) 2000, Brooks/Cole Publishing Company (Asian Books Pvt.Ltd.), New Delhi.
2. Robert Thornton Morrison and Robert Neilson Boyd: *Organic Chemistry* (6th Ed.) 1999, Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Jerry March: *Advanced Organic Chemistry* (4th Ed.) 2000, John Wiley and Sons., New York.
4. Ernest L. Eliel: *Stereochemistry of Carbon Compounds*, 1998, Tata-McGraw-Hill Pub. Co. Ltd., New Delhi.

CSC 191 (Credit hours 3)

Computer Science (Introductory)

B. Pharm., First Year, First Semester

Course Objectives:

The objective of the course is to provide the students with a general view of computer architecture, its operation and application, familiarize the students with the existing technologies, and provide them with hands on experience on personal computers

Unit	Course Description	Hrs.	Details
1	Introduction to Computers History of Computers, Classification of Computers, Functioning of Computers, Computer Hardware, Software, firmware.	3	Definition, Evolution of digital computer/computer generation/classification on the basis of size/brand/working principle(Analogue/Digital/Hybrid)/ earlier classification (Micro, Mini, Mainframe, Super) characteristics of computer(Speed ,Storage, Accuracy, Versatile, Diligence) defined soft /hardware and firmware with example
2	Number System Decimal number system, Binary number system, Hexadecimal number system, Octal number system, Conversion of a number from one system to other, Addition and Subtraction of binary numbers, Compliments, Subtraction by 2's compliment method	6	Definition with examples/ Conversion from one to other number systems.
3	Boolean Algebra and Logic Gates Introduction, Basic operations of Boolean algebra, DeMorgan's Theorem, Boolean variable and function, Boolean postulates, Dual and compliments of Boolean expression, SOP and POS standard forms, Canonical forms of Boolean expression, Simplification of Boolean expressions by Karnaugh method, Logic Gates-AND, OR, NOT, NOR, XOR, XNOR	5	
4	Arithmetic Logic Unit and Memory Element Half adder, Full adder, Flip-flop, R-S flip-flop	2	Defined

5	Memory Classification, RAM, ROM, Floppy disk, Hard disk	3	
6	Input Output Devices and Computer Network Role of input and output devices, Keyboard, Mouse, Scanners, MICR, Video terminals, Printers, Plotters, Digital to analog conversion, Introduction to computer network, Sharing, Network types	5	Transmission media – Twist pair, Coaxial / Fiber optic Network model (Peer to Peer, C/S) Network types(LAN,WAN, MAN) Network Topology(Star, Ring, Bus, Mess)
7	Word Processing Introduction, Concept of file, Inputting the text, Formatting, Inserting the files and Symbols, Mail merge facility, Grammar checking, Auto correct feature (MS-Word is to be used)	4	
8	Spreadsheet Analysis Introduction to spreadsheets, Workbook and worksheet, Formula, Formatting and Graphics (MS-Excel is to be used)	4	Create a mark sheet and drugs storage file in excel (Practical)
9	Database Management Data, Database, Input, Processing, Storage, Output (MS-Access is to be used)	4	
10	Internet and Multimedia Introduction to Internet, e-mail, Introduction to slide, Making a presentation (MS-PowerPoint is to be used)		Create 2-5 slides with animation (Assignment)
11	Programming Concepts Difference between a computer and calculator Algorithm, Flowchart, Program, Programming language	5	Algorithm and flowcharts of sum, average, if else structure
Recommendation: Data analysis tools (SPSS) <i>Introduction, defining variables, data entry and create table and produce chats (very beginning concept so that the student after completion here, can keep record on spss and analysis their records of their form).</i>			

Reference Books:

1. B. Ram: *Computer Fundamentals*, 1999, Willey Eastern Publication, New Delhi.
2. O. S. Lawrence: *Schaum's Outline of Computers & Business*, 2000, Mc-Grew Hill International., New Delhi.
3. Suresh Basandra: *Computer Systems Today*, 1999, Galgotia Publication, New Delhi.
4. M. Busby and R. A. Stultz: *Office 2000*, 2000, BPB Publication, New Delhi.

MTH 192 (Credit hours 3)**Mathematics (Algebra, Trigonometry and Calculus)**
B. Pharm., First Year, First Semester**Course Objectives:**

This course deals with the basic principles of mathematics, which will enable the students to apply these tools in pharmaceutical problems

Unit	Course description	Hrs.	Topic	Allocation of hours
1	Theory of Sets Introduction, Types of sets, Venn diagram, Set operation, Number of element in a set, Application	5	Introduction, Types of sets, Venn diagram, Set operation, Number of element in a set, Application	1 1 1 2
2	Function and Graph Definition, Injective, surjective and bijective functions, Inverse function, Polynomial, Exponential, Logarithmic, and Trigonometric functions and their graphs, Applications	9	Definition, Injective, surjective and bijective functions, Inverse function, Polynomial, Exponential, Logarithmic, Trigonometric functions and their graphs, Applications (Word problem)	2 1 1 1 1 1 1
3	Limit and Continuity Definition, Limit of a function, Continuity of a function	3	Definition, Limit of a function, Continuity of a function	2 1
4	Derivatives Definition, Techniques of differentiations, Derivatives of algebraic, exponential, logarithmic, and trigonometric functions, Derivatives of higher order, Optimization problems, Partial differentiation, Application	12	Definition, Techniques of differentiations, Derivatives of algebraic, exponential, logarithmic, trigonometric functions, Derivatives of higher order, Optimization problems, Partial differentiation, Application	1 1 1 1 1 2 2 1 1
5	Integration Indefinite integrals, Techniques of integration, Definite integral, Application	8	Indefinite integrals, Techniques of integration, algebraic expression trigonometric	2 2

			Definite integral, algebraic expression trigonometric	2 2
6	Ordinary Differential Equation and its Application Introduction, Classification, Separation of variables, Exact equations, Linear first order equations, Homogenous equation, Application	8	Introduction, Classification, Separation of variables, Exact equations, Linear first order equations, Homogenous equation, Application	1 1 2 2 2

Reference Books:

1. Ruric E. Wheeler, W. D. Peeples: *Modern Mathematics with Application to Business and Social Sciences*, 2000, Brooks / Cole Publishing Company, New York.
2. Larry J. Gildstein, David C. Lay, David I. Schneider: *Calculus and its Application*, 2001, Prentice Hall International, Inc., New Jersey.
3. Frank S. Budnick: *Applied Mathematics for Business, Economics and the Social Sciences* (4th Ed.) 1993, McGraw-Hill, Inc., New York.
4. Bernard J. Rice and Jerry D. Strange: *Technical Mathematics and Calculus*, 2000, Prindle Weber and Schmidt, New York.
5. George B. Thomas, Jr., Ross L. Finney: *Calculus and Analytic Geometry* (6th Ed.) 1998, Narosa Publishing House, New Delhi.

ENG 193 (Credit hours 3)

Communication Skill (Technical English)

B. Pharm., First Year, First Semester

Course Objectives:

This course is designed to develop the reading, writing and expressing skills in technical English.

Unit	Course Description	Hrs.	Details
1	Review of Written English Sentence structure (identification of sentence or its types and transformation of sentences)	3	1. Brief discussion of sentence structure. 2. Sentence types:- a) Rhetorical type: i) Introduction of simple, complex and compound sentences. ii) Ways of Identification of these sentences and iii) transformation of these sentence types into each other. b. Grammatical Type i) short introduction of declarative, interrogative, exclamatory and imperative sentence
2	Oral Communication and Note Taking Types of English (variety levels of English), Technical talk (Environmental pollution, Construction, Water resources, Impact of computer in modern society, Impact of satellite communication, Urban development)	15	❖ <i>Types of English :-</i> 1. On the basis of Education- a) Standard English :- Short introduction of its types: i) Formal ii) Informal iii) Colloquial b) Non-Standard English 2. On the basis of Geography and Nationality :- a) British English b) American English Some of the major differences between American and British English regarding spelling, sentence formation etc. ❖ <i>Technical Talk</i> 1. Brief discussion on the features of different <i>technicality level</i> :- a) Highly Technical Level b) Semi-technical Level c) Non-technical Level 2. Teaching students about

			<p>different <i>delivery techniques</i> :-</p> <ol style="list-style-type: none"> a) Impromptu Delivery b) Memorized Delivery c) Read Delivery d) Extemporaneous Delivery <p>3. Application of these techniques into practical level by encouraging students orally as well as theoretically on the prescribed course content.</p> <p>❖ <i>Note Taking</i>:-</p> <p>Styles of Note Taking:-</p> <ol style="list-style-type: none"> 1) Arabic Numerals: 1,2,3,4... 2) Decimal System: - 1.1, 1.2... 3) Small Roman Numerals:- (i), (ii), (iii) 4) Large Roman Numerals:- I, II, III ... 5) Capital Letters:- A,B,C,D... 6) Small Letters:- a,b,c,d, 7) Hanging Way 8) Practical Work
3	<p>Technical Writing Skill</p> <p>Preparation of short memoranda (Importance-formats), Business letters (Importance-purposes), Preparation of application (Job application-biodata), Description writing (Process, Mechanism, Place etc.), Seminar papers (Conduction of seminar, Preparation of circular, presenting seminar paper), Preparation of proposals (Importancetype- formats), Preparation of reports (Importance-types-formats).</p>	10	<p>❖ <i>Memoranda</i>:-</p> <ol style="list-style-type: none"> a. Definition b. Purpose c. Components d. Language e. Sample Memo <p>❖ <i>Business Letters</i></p> <ol style="list-style-type: none"> a) Principles of Effective Business Letter Writing : i) Courtesy and Consideration ii) Clarity and Precision iii) Conciseness b) Structures of Business Letter: <ol style="list-style-type: none"> i) Blcoked style ii) Semi-blocked style c) Elements of Business Letter: <ol style="list-style-type: none"> i) Heading ii) Date iii) Reference

		<ul style="list-style-type: none"> iv) Inside Address v) Salutation vi) Subject vii) Body viii) Conclusion ix) Signature x) Enclosure d) Major Types of Business Letter <ul style="list-style-type: none"> i) Complaint Letter ii) Invitations iii) Ordering products iv) Job Application e) Sample Business Letter: <ul style="list-style-type: none"> ❖ <i>Report Writing</i> <ul style="list-style-type: none"> a) Introduction to report writing b) Types of Report <ul style="list-style-type: none"> i) Accident/ Incident reports ii) Feasibility reports iii) Inventory reports iv) Staff Utilization reports v) Progress/Activity Reports vi) Travel/ Trip Reports vii) Lab Reports viii) Performance Appraisal Report ix) Study Reports x) Justification Reports <ul style="list-style-type: none"> c) Criteria for writing reports <ul style="list-style-type: none"> i) Organization ii) Development c) Sample Report <ul style="list-style-type: none"> ❖ <i>Description Writing</i> <ul style="list-style-type: none"> a) Process b) Mechanism c) Sample description writing <ul style="list-style-type: none"> ❖ <i>Circular</i> <ul style="list-style-type: none"> a) Introduction b) Sample Circular <ul style="list-style-type: none"> ❖ <i>Seminar Paper</i> <ul style="list-style-type: none"> a) Conduction of Seminar b) Preparation of Seminar Paper c) Presentation of Seminar Paper <ul style="list-style-type: none"> ❖ <i>Proposal Writing</i> <ul style="list-style-type: none"> a) Introduction of Proposal b) Importance of Proposal
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			c) Types of Proposal i) Short Proposal/ Long Proposal ii) Solicited Proposals/ Unsolicited Proposals iii) Internal Proposal/ External Proposal d) Formats of Proposal e) Sample Proposal
4	Reading Skill Comprehension questions and exercises (from prescribed passages- freedom, kinship and the family, Marconi and the invention of Radio, Road foundation, The turbo-prop engine, The use and misuse of science and grief), Outlining or note making from any passages, Precis writing from any passages	17	1) Introduction to critical reading a) Reading the poetics of the text i) Considering text's stylistic method and knowing the different styles of expressing the message of different writers. b) Reading the politics of the text i) Interpreting text through various critical stand points 2) The standard technique of summary writing 3) Encouraging students to make the sensible interperetation of their own about the prescribed texts.

RECOMMENDATIONS AND SUGGESTIONS

- 1. This course is prescribed to the students of B. Pharm. 1st Semester. There remains one major problem that when students go to market after 4 year they may forget this teaching. So, it is suggested that if this course is included in the last semester, students will successfully and effectively use the knowledge in market which they studied in class.**
- 2. In Reading skills, the content and the time do not match each other. Content is less than the given time frame. So, some recent literary text if are included, they will create a good compatible relation with time and content.**

Reference Books:

1. Anne Eisenberg: *Effective Technical Communication*, 1982, McGraw-Hill, Inc., New York.
2. A. Houp and T. E. Pearsall: *Reporting Technical Information*, 1998, Allyn and Bacon, Boston.
3. V. R. Narayanaswami: *Strengthen Your Writing*, 2000, Orient Longman, Madras.
4. Champa Tickoo and Jaya Sasikumar: *Writing with a Purpose*, 1999, Oxford University Press, Bombay.
5. A Handbook of Pronunciation of English Words (with 90 minutes audio cassette)
Communication Skill in English.

LAB-1 (Credit hour 1)

Pharmaceutical Laboratory-1

B. Pharm., First Year, First Semester

Course Objectives:

Introduction to laboratory and basic chemical procedures

Course Contents:

1. Laboratory safety, Chemical hazards, Prevention of accidents and Use of reagents and labelling
2. Use of Physical balance, Chemical balance, Micropipettes
3. Pharmacopoeial control and identification tests for important drugs and poisonous substances, environmental hazards, disposal of chemicals
4. Use of pipette, burette and balance (calibration), Standardization of solutions in volumetric analysis.
5. Limit tests for As, Hg, Pb, Fe, Cl and SO₄
6. Estimation of saline solution and calcium
7. Acid/base titration
8. Determination of specific gravity of liquids/syrups/acids etc

Reference Books:

1. John McMurry and Mary E. Castellion: *Fundamentals of General, Organic and Biological Chemistry* (2nd Ed.) 1996, Prentice Hall Inc., New Jersey.
2. Louis F. Fieser: *Organic Experiments*, 1994, CBC Publishers and Distributors, New Delhi.
3. A. H. Beckett and J. B. Stenlake: *Practical Pharmaceutical Chemistry* (4th Ed.) 2000, CBC Publishers and Distributors, New Delhi.

FIRST YEAR

SECOND SEMESTER

SECOND SEMESTER

Code	Description	Credit hours	Pre-requisite course	Core Course
PHT 102	Pharmaceutics II (Physical Pharmacy)	3	PHT 101	☼
BCM 121	Biochemistry I	3	.....
APL 131	Anatomy and Physiology I	3	.....
PHC 173	Pharmaceutical Chemistry III (General Chemistry)	3	PHC 171	
PHG 181	Pharmacognosy I (Medicinal Botany)	3	.....	☼
MTH 194	Biostatistics	3	.....	.....
LAB-2	Pharmaceutical Laboratory 2	1	.....	.....
LAB-3	Pharmaceutical Laboratory 3	1	.....	.....
LAB-4	Pharmaceutical Laboratory 4	1	.....	.....
SEM-1	Pharmaceutical Seminar-1	1	.....	.....
TOTAL		22		

PHT 102 (Credit hours 3)**Pharmaceutics II (Physical Pharmacy)**

B. Pharm., First Year, Second Semester

Course Objectives:

This course will provide students the physico-chemical phenomena of the substances essential for drug formulation

Unit	Course Description	Hours	Details
1	Physico-Chemical Principles	10	
	A systematic study of the application of physico-chemical principles to pharmaceutical and biomedical sciences, Solubility, Isotonicity, pH, Drug stability and degradation		A systematic study of the application of physico-chemical principles to pharmaceutical and biomedical sciences, Solubility: Methods of expressing solubility, Prediction of solubility, Physicochemical prediction of solubility, Solubility parameter, Solubility of solids in liquids, Determination of the solubility of a solid in a liquid, Factors affecting the solubility of solids in liquids, Solubility of gases in liquids, Solubility of liquids in liquids, Systems showing an increase in miscibility with rise in temperature, Systems showing a decrease in miscibility with rise in temperature , Systems showing upper and lower critical solution temperatures, The effects of added substances on critical solution temperatures, Distribution of solutes between immiscible liquids, Partition coefficients, Solubility of solids in solids. Isotonicity: Isotonicity modifiers and their pharmaceutical applications. pH: pH effects, pH modifiers, pH-partition hypothesis. Drug stability and degradation
2.	Surface Phenomena	10	
	Interfacial properties of surface active agents, Micellization, Micellar structure, Micellar solubilization and its pharmaceutical application		Surface and Interfacial Phenomenon: Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, adsorption at solid and liquid interfaces, complex films,

			electrical properties of interface. Surface-active agents: Classifications, mechanism of actions and their roles in pharmacy. Micellization, Micellar structure, Micellar solubilization and its pharmaceutical application.
3.	Disperse System	12	
	a. Classification of colloids, Properties of colloidal solutions, Electrical double layer, Stability of lyophobic and b. hydrophobic colloids, Coacervation and dialysis c. Gels: Properties of gels, Diffusion in gels		Disperse system: The colloidal state, classification of colloids, Preparation, properties of colloidal sols, Electric double layer, Origin of the charge, stability of colloids, sedimentation, stoke's law, viscosity of colloids, coacervation, Dialysis, properties of gels, Diffusion in gels. Protective colloid, sensitization, dialysis, Donnan membrane equilibrium, application and uses of colloidal preparation in pharmacy.
4.	Powder Technology	8	
	Particle shape and size, Particle size analysis, Surface area of powders, Powders flow properties		Powder Technology: Particle size and distribution, average particle size, number and weight distribution, particle number, method of determining particle volume, sieving, sedimentation and measurement thereof, particle shape, specific surface, determination of surface area, permeability, derived properties of powder, porosity, packing arrangements, density, bulkiness and flow properties.
5.	Rheology	5	
	Rheology, Newtonian and Nonnewtonian system, Thixotrophy, Determination of rheological properties and its application in pharmacy		Rheology: Newtonian systems, Law of flows, kinematics viscosity, effect of temperature, non-Newtonian system: pseudoplastic, dilatant and plastic flows, thixotropy, thixotropy in a formulation, and determination of viscosity. Determination of rheological properties and its application in pharmacy.

Reference Books:

1. A.T. Florence and D. Attwood: *Physico-chemical Principles of Pharmacy* (2nd Ed.) 1994, The MacMillan Press Ltd., London.
2. E. A. Rowlinson (Ed.): *Bentley's The Textbook of Pharmaceutics* (8th Ed.) 2001 Bailliere Tindall, London.
3. Michael E. Aulton (Ed.): *Pharmaceutics, The Science of Dosage Form Design*, 1999, Churchill Livingstone, International Student Edition, Edinburgh.
4. Howard C. Ansel, Nicholas G. Popovich and Loyd V. Allen: *Pharmaceutical Dosage form and Drug Delivery System* (6th Ed.), 1995, B. I. Waterly Pvt., Ltd., New Delhi.

BCM 121 (Credit hours 3)**Biochemistry I
(General)**

B Pharm, First Year, Second Semester

Course Objectives:

This course will provide the students about the knowledge on general principles of biochemistry applicable to pharmaceutical sciences.

Unit	Course Description	Hrs.	Details	Suggestion
1.	Physicochemical Phenomena	5 hours		
	Importance of physicochemical phenomena in Biochemistry, Colloidal state, Surface tension, Viscosity Osmosis, Diffusion, Buffers, pH, Significance of pH, Henderson-Hasselbalch equation		Importance of physical phenomena in Biochemistry, Colloidal state, Surface tension, Viscosity, Osmosis, Diffusion Importance of chemical phenomena in Biochemistry, ionization, pH, Significance of pH, Henderson-Hasselbalch equation, Buffer Solution	5 hrs
2.	Chemistry and Metabolism of Carbohydrates	15 hours		
	Introduction, Classification, Monosaccharides, Disaccharides, Polysaccharides, Carbohydrate derivatives, Glycogenesis, Glycogenolysis, Gluconeogenesis, Glycolysis, Tricarboxylic acid cycle, Hexose monophosphate shunt, Effect of hormones on carbohydrate metabolism		1. Chemistry of Carbohydrates ; 2 hours Introduction, Classification, (Monosaccharides, Disaccharides, Polysaccharides) Nomenclature and Carbohydrate derivatives Physicochemical property 2. Metabolism of Carbohydrates: 5 hours Glycolysis Glycogenesis and Glycogenolysis Gluconeogenesis, Hexose monophosphate shunt Effect of hormones on carbohydrate metabolism	Following unit is suggested to add as a 5th unit (Citric acid cycle and biological oxidation 3 hours 1. Citric acid cycle 2. Organization of electron transfer chain 3. ATP synthase

			<p>Citric acid cycle and biological oxidation (3 hours)</p> <p>Citric acid cycle, Organization of electron transfer chain, ATP synthase</p>	
3.	Chemistry and Metabolism of Lipids	12 hours		
	<p>Introduction, Classification, Characterization tests, Fats, Waxes, Soaps, Phospholipids, Glycolipids, Steroids and Sterols, Theories of fat absorption, Oxidation of fatty acids, Synthesis of fatty acids, Abnormalities of lipid metabolism, Eicosanoids, Prostanoids, Leukotrienes, Lipoxygenase and cyclo-oxygenase pathway, Peroxidation of Lipid, Diphoters, HDL, LDL, VLDL</p>		<p>1. Chemistry of Lipids 4 hours</p> <ul style="list-style-type: none"> • Introduction and Classification of lipid • Fats, Waxes, Soaps, Phospholipids, Glycolipids <p>Steroids and Sterols Eicosanoids, Prostanoids, Leukotrienes, Cholesterol and phospholipids HDL, LDL, VLDL</p> <p>2. Metabolism of Lipids:5 hours</p> <p>heories of fat absorption Oxidation of fatty acids De novo Synthesis of fatty acids Lipoxygenase and cyclo-oxygenase pathway, Peroxidation of Lipid</p>	<p>1. 14 hrs</p> <p>2. Following topics are suggested to add</p> <p>3. Theories of fat absorption</p> <p>4. Peroxidation of Lipid</p>
4.	Chemistry and Metabolism of Proteins	13 hours		
	<p>Introduction, Classification, Occurrence, General properties, Amino acids,</p> <p>Physicochemical properties, Structure of protein molecule, Metabolism of individual amino acids (e.g. phenyl alanine and tyrosine metabolism), Protein biosynthesis,</p>		<p>Chemistry of Amino acid Introduction and Classification Physicochemical properties, Biomedical importance Chemistry of Proteins Introduction and Classification, General properties and Physicochemical properties</p>	<p>11 hrs</p> <p>1. (Nucleic acids, Nucleotides, Nucleosides, RNA synthesis, Initiation, Translation Elongation, Genetic code</p>

	Nucleic acids, Nucleotides, Nucleosides, RNA synthesis, Initiation, Translation Elongation, Genetic code and Protein synthesis		Structure of protein molecule, Quantitative estimation of protein Metabolism of individual amino acids : Glycine, Methionine Serine, phenyl alanine, tyrosine	and Protein synthesis) repeated in CBL241.3 so suggested to exclude from BCM 121.3
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Reference Books:

1. Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W: Rodwell, *Harper,s Biochemistry* Latest Ed. Appleton and Lange, Stanford, CT.
2. Lubert Styrer: *Biochemistry* (4th Ed.) W. H. Freeman and Company.
3. David L. Nelson and Michel M. Cox: *Lehninger's Principles of Biochemistry*, (3rd Ed.) 2000, Macmillan Worth Publisher.
4. R. A. Harvey and P. C. Champe: *Lippincott's Illustrated Review: Biochemistry* (3rd Ed.) 2004, Lippincott Williams and Wilkins

APL 131 (Credit hours 3)

Anatomy and Physiology I

B. Pharm., First Year, Second Semester

Course Objectives:

This course will provide the basic knowledge on the structure and function of human body, which will enable the students to understand scientific basis of the drug action.

Unit	Course Description	Hours	Details	Suggestions
1	The Cell (Structure and Function)	10		
	An organization of the cell, The membranous structure of the cell, The cytoplasm and its organelles, Functional systems of the cell, Diffusion, Kinetics of diffusion, Diffusion through the cell membrane, Active transport, Pinocytosis and Phagocytosis		<ul style="list-style-type: none"> • Organization of the cell- Different substances that make up the cell, • Membranous str of the cell- membranes include the cell membrane, nuclear membrane, membrane of the endoplasmic reticulum, and membranes of the mitochondria, lysosomes, and Golgi apparatus. Lipid barrier, cell membrane protein and carbohydrate, • Cytoplasm and its organelles- definition of cytoplasm with knowledge regarding the endoplasmic reticulum, the Golgi apparatus, mitochondria, lysosomes, and peroxisomes, nucleus • Functional systems of the cell- Defn of endocytosis, pinocytosis, phagocytosis, functions of lysosome, formation of cellular str by ER and golgi apparatus. • Diffusion- defn, Diffusion of Lipid-Soluble Substances , Diffusion of Water and Other Lipid-Insoluble Molecule, Diffusion Through Protein Channels, and “Gating” of These Channels, Facilitated Diffusion, Factors That Affect Net Rate of Diffusion, • Osmosis Across Selectively 	

			Permeable Membranes, Osmotic Pressure, • “Active Transport” of Substances Through Membranes	
2.	Blood	8		
	An introduction of haematology, Functions of blood, Composition of blood, Blood coagulation, Formed elements of blood, Homeostatic imbalances of blood, Blood groups, Interstitial fluid and lymph, Body fluids, Lymphatic system, Reticuloendothelial system		Introduction of hematology- defn of hematology, branches and importance of hematology Functions of blood Production of Red Blood Cells- Areas of the Body That Produce Red Blood Cells, Pluripotential Hematopoietic Stem Cells, Growth Inducers, and Differentiation Inducers, Stages of Differentiation of Red Blood Cells, Regulation of Red Blood Cell Production, Maturation of Red Blood Cells, Formation of Hemoglobin (Oxygen transport by haemoglobin), Production of WBC- Genesis of Myelocytes, Genesis of Lymphocytes, functions and structures of various types of leucocytes, Production of platelets Composition of blood- plasma and types of blood cells with their proportion (Blood Count) Blood coagulation- events in hemostasis, Clotting Factors in Blood, extrinsic and intrinsic pathway of coagulation, role of calcium in coagulation, knowledge regarding heparin and plasmin Hemostatic imbalances of blood- Anemia(Types: Megaloblastic, sickle cell, pernicious,iron deficiency, microcytic, normocytic, hemolytic, congenital, acquired, sideroblastic), polycythemia,	**blood coagulation tests (BT, CT, PT, aPTT, INR) **Body Fluid Compartments- the extracellular fluid and the intracellular fluid, transcellular fluid, Constituents of Extracellular fluid, Important Constituents of the Intracellular Fluid,

			<p>leukemia, leukocytosis, leukopenia ,Conditions That Cause Excessive Bleeding in Human Beings (1) vitamin K deficiency, (2) hemophilia, and (3) thrombocytopenia (platelet deficiency).</p> <p>Blood groups- O-A-B Blood Types, Agglutination Process In Transfusion Reactions, Blood Typing, Rh Blood Types, Erythroblastosis Fetalis (“Hemolytic Disease of the Newborn”), Transfusion Reactions Resulting from Mismatched Blood Types, storage of blood</p> <p>The interstitium and interstitial fluid, the lymphatic system, Lymph nodes and lymph channels of the Body, flow and formation of lymph, function of spleen, thymus. Types and causes of edema. Reticuloendothelial system</p>	
3.	Digestive System	8		
	<p>An introduction of digestive system, Anatomy of gastrointestinal tract, Gastrointestinal movements, Deglutition, Secretions of digestive enzymes, Digestion, Absorption, Defecation, Homeostatic imbalances of the digestive system</p>		<ul style="list-style-type: none"> • Physiologic Anatomy of the Gastrointestinal Wall, Electrical Activity of Gastrointestinal • Smooth Muscle, Neural Control of • Gastrointestinal Function— Enteric Nervous System, Gastrointestinal Reflexes, Functional Types of Movements in the Gastrointestinal Tract, mastication, deglutition, motor functions of stomach, 	

			<p>movements of Small intestine, movements of colon, defecation and defecation reflex,</p> <ul style="list-style-type: none"> • Secretions of digestive enzymes- Anatomical Types of Glands, Basic Mechanism of Secretion by Glandular Cells, Secretion of Saliva, Gastric Secretion and its phases, Pancreatic Secretion, Secretion of Bile by the Liver; Functions of the Biliary Tree, Secretions of the Small Intestine, Secretions of the Large Intestine, Digestion of carbohydrates, fats and proteins. Absorption of glucose, fatty acids, aminoacids and mineral ions. • Homeostatic imbalances of digestive system- Achalasia cardia, Acid peptic diseases, pancreatic failure, intestinal sprue, constipation and diarrhea, vomiting and nausea. 	
4.	Excretory System	7		
	<p>An introduction to excretory system, Anatomy of kidney, Glomerular filtration, Reabsorption and secretion in the tubules, Acid-base balance, Counter current mechanism, Renal disease, Micturition, Abnormalities of micturition</p>		<p>Physiologic anatomy of excretory system- General Organization of the Kidneys and Urinary Tract, Urine Formation Resulting from Glomerular Filtration, Tubular Reabsorption, and Tubular Secretion, GFR and its determinants, physiological control of glomerular filtration and renal blood flow, Autoregulation of GFR and Renal Blood Flow, Acid base balance by kidneys- the renal buffer system, counter current mechanism and its importance, Renal diseases- medico renal</p>	

			<p>diseases like acute renal failure, chronic renal failure, nephritic and nephritic syndrome.</p> <p>Micturition- definition, transport of urine from kidneys to bladder, filling of bladder and cystometrogram, micturition reflex and steps of micturition, abnormalities of micturition like- atonic bladder, automatic bladder, neurogenic bladder.</p> <p>Terminologies: polyuria, oliguria, anuria, nocturia, glycosuria, hematuria, proteinuria.</p>	
5.	The Functioning Nerve Cell	4		
	Nervous system, Electrical concepts for Neurophysiology action potential, impulse conduction, Synapses neurotransmitter substances		<ul style="list-style-type: none"> • Nervous system and its classification, • basic concepts of membrane potential, resting membrane potential and action potential, propagation of action potential, • Special Characteristics of Signal Transmission in Nerve Trunks. • Synapses- definition and types with impulse conduction across the synapse. • Neurotransmitters- definitions, types and functions. 	
6.	The Functioning Muscle Cell	4		
	Classification of Muscle cell, Muscle structure and function, Homeostasis imbalances of neuromuscular junctions or muscle tissue		<ul style="list-style-type: none"> • Physiologic anatomy of muscle fibres, • structure and function and classification of muscle, • general and molecular mechanism of muscle contraction, • The Neuromuscular Junction, Molecular Biology of Acetylcholine Formation and Release, 	

			<ul style="list-style-type: none"> • Homeostatic imbalances of neuromuscular junctions like-myasthenia gravis. • Knowledge regarding rigor mortis 	
7.	The Autonomic Nervous System	4		
	Structure and physiology, Control of autonomic nervous system by the central nervous system		<ul style="list-style-type: none"> • Sympathetic and parasympathetic nervous system, • neurotransmitters, • receptors and their location, • Structure and physiological functions of ANS. 	

Reference Books:

1. Peter L. Williams et al. (Ed.): *Gray's Anatomy* (38th Ed.) 1995, Churchill Livingstone, Edinburgh.
2. Chummy S. Sinnatamby: *Last's Anatomy Regional and Applied*, 1999, Churchill Livingstone, Edinburgh.
3. Arthur C. Guyton and John E. Hall: *The Textbook of Medical Physiology* (10th Ed.) 2000, Harcourt India Private, New Delhi.

PHC 173 (Credit hours 3)**Pharmaceutical Chemistry III (General Chemistry)**

B. Pharm., First Year, Second Semester

Course Objectives:

This course is designed to provide the knowledge on the physical properties of the matter applicable to pharmaceutical preparation.

Unit	Course Description	Hours	Details
1.	Physical Properties of Molecules	5	
	Surface and interfacial tension, Viscosity, Dielectric constant, Dipole moment, Refractive index and Optical rotation		<ul style="list-style-type: none">• Definition of surface tension and interfacial tension.• Give the idea of mathematical relation of surface tension and its SI unit.• Define the effect of temperature on surface tension and viscosity.• Clear the concept of surfactant and parachor.• List the important uses of surface tension and viscosity.• Definition of coefficient of viscosity with ISI units• Give the idea of fluidity.• Definition of dipole moment and its SI unit.• Clear the concept of application of dipole moment to predict the structure of SO₂, CH₄, NH₃, H₂O as well as identification of cis and trans isomers.• Give the concept of calculation of percentage of ionic character of polar covalent compound through dipole moment.• Discuss the concept of dielectric constant and its important applications.• Definition of refractive index and optical rotation of optically active molecules in plane polarized light.• Application of this concept to determine the concentration of unknown solution.

2.	Solutions Types and properties, Solubility and solubilization, Solutions of electrolytes and non-electrolytes, Dissolution and dissolution rates, Distribution phenomena; Theory of distillation, Molecular weight determination	6	<ul style="list-style-type: none"> • Discuss solution and its ten types with examples. • Discuss the methods of expressing the concentration of solution. • Discuss isotonic, hypertonic and hypotonic solution simple examples. • Discuss solubility and principle of solubility. • Discuss solubilization with examples. • Discuss the properties of solution including colligative, additive and constitutive. • Discuss distribution phenomena • Discuss Nernst distribution law and Henry's distribution law with illustrations. • Solved the problems related to these laws. • Discuss the theory of steam distillation. • Discuss the molecular mass determination. • Solved general problems related to these concept •
3.	Ionic Equilibrium Modern theories of acids, bases and salts, pH and acidity constants, Theory of indicators, Buffers and buffered system	6	<ul style="list-style-type: none"> • Explain the Arrhenius concept of acids and bases with examples and limitations. • Explain the Bronsted –Lowary concept of acid and bases with examples. • Explain the meaning of conjugate acid base pairs. • Explain the Lewis concepts of acids and basses with examples. • Explain the relative strength of acids, bases and calculations of relative strength of weak acids and bases. • Explain the meaning of P^H, P^{OH} and p^H of solution. P^H scale and some numerical problems based on p^H. • Explain the Oswald's theory and

			<p>quinonoid theory of indicators.</p> <ul style="list-style-type: none"> • Explain the buffer solution, its types with examples. • Explains the mechanisms of buffer action of acidic and basic buffer. • Explain the buffer capacity and buffer range. • Explain the simple calculation base on buffer solutions.
4.	Phase Equilibrium	5	
	Phase rule and its applications to one and two component systems		<ul style="list-style-type: none"> • Give the definition of phase with examples of one, two and three phase system at least two examples. • Give the definition of component with at least two examples. • Give the definition of and meaning of degrees of freedom with examples. • Give the concept of no variant, univariant and bivariant with examples. • Give the derivations of Gibb's phase rule for heterogeneous system in equilibrium ($F = C - P + 2$) • Give the advantages of phase rule. • Give the limitations of phase rule. • Give the applications of phase rule in one component systems with reference to water system and helium system. • Give the concept of eutectic point and eutectic system. • Give the applications of phase rule in two component systems with reference to solid – liquid system, phenol water system and silver- lead system
5.	Electrochemistry	7	
	Conductivity and its measurement, Conductometric titration, Electrochemical cells, Determination of pH and Redox potentials, Acid/base and Redox		<ul style="list-style-type: none"> • Explain the meaning of conductivity of electrolytic solution and its variation with dilution. • Definition of ionic, equivalent, molar, and specific conductance and its

	titration, Electrophoresis and Electro dialysis		<p>relation with cell constant.</p> <ul style="list-style-type: none"> • Units related to them. • Determination of electrolytic conductance by using modified form of Wheatstone bridge. • Simple calculation based on conductivities. • Definition of electrolytic cell, electrolysis and criteria of product formation in electrolysis. • Discuss the determination of p^H and redox potentials. • Discuss the different types of titration curves obtained by titrating Strong acid versus strong base Strong acid versus weak base Weak acid versus strong base Weak acid versus weak base. • Explain electrophoresis processes with examples. • Explain the electro dialysis and purification of sols.
6.	Thermodynamics and Thermochemistry	8	
	First and second law of thermodynamics, Thermochemistry, Free energy functions and application		<ul style="list-style-type: none"> • Definition of homogeneous and heterogeneous system with examples. • Definition of state of the system and state functions. • Definition of equilibrium and non equilibrium states with examples. • Definition of thermodynamic process and their types. • Give the concept of reversible and irreversible processes. • Give the concept of nature of heat and work. • Give the concept of internal energy of the system. • Give the different statement as well as mathematical statement of first law of

			<p>thermodynamics.</p> <ul style="list-style-type: none"> • Give the significance of first law of thermodynamics. • Give the limitations of first law. • Definition of spontaneous and non spontaneous process with examples. • Give the physical concept of entropy. • Give the concept of entropy change in spontaneous process or second law of thermodynamics. • Definition of Gibb's free energy functions. • Relations of free energy change with change of enthalpy and entropy of the system. • Give the relation of Gibb's free energy with chemical reactions. • Give the concept of fugacity and activity • Give the concept of enthalpy of a system with examples. • Give the some concept of heat of reaction. • Give the some concept of different types of heat of reactions including heat of formation, heat of hydration, heat of combustion, heat of neutralization. Calorific values of foods and fuels. • Give the theoretical justification of Hess's law of constant heat summation with examples. • Give the idea of applications of Hess's law to determine heat of formation, bond energy calculation and enthalpy of neutralization and transition. • Simple calculation based on above mention topics.
7.	Chemical Kinetics	8	
	Rates and order of reaction, Influence and other factors on reaction rate, Acid-base catalysis, Decomposition of medicinal		<ul style="list-style-type: none"> • Definition of rate of reaction and its unit. • Give the idea of average and instantaneous reaction rate.

	compounds, Accelerated stability analysis, Kinetics of enzyme-catalyzed reaction		<ul style="list-style-type: none"> • Give the idea of different factors such as conc., temp, catalyst, surface area light pressure etc which influences the reaction rate with examples. • Definition of order of reaction, differential law, equation of first and second order reaction with examples. • Clear the concept of order and molecularity of a reaction with example. • Calculation involving the determination of order of reaction with respect to individual components, overall order, differential rate law equation and rate constant. • Definition of half life, derivation of half life equation belongs to first order reaction only. • Give the idea of increase of rate of reaction with respect to temperature by collision theory and Arrhenius equation. • Give the idea of transition state theory. • Clear the concept of energy profile diagram of enzyme catalyzed and uncatalyzed reaction with examples. • Give the concept of accelerated stability analysis of drugs. • Discuss the kinetics of enzyme catalyzed reaction with examples.
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Reference Books:

1 Samuel H. Maron and Carl F. Prutton: *Principles of Physical Chemistry* (4th Ed.) 1972, Oxford and IBM Publishing Co. Pvt. Ltd., New Delhi.

2 B. S. Bahl, G. D. Tuli and Arun Bahl: *Essentials of Physical Chemistry* (24th Ed.) 2000, S. Chand and Company Ltd., New Delhi.

PHG 181 (Credit hours 3)**Pharmacognosy I (Medicinal Botany)**

B. Pharm., First Year, Second Semester

Course Objectives:

This course is designed to understand the basic principles of pharmacognosy, which will enable the students to identify crude drugs and respective medicinal plants.

Unit	Course Description	Hours	Details
1.	Introduction	4	
	Plants in medicine, The origin of pharmacognosy, The scope and practice of pharmacognosy, Plant nomenclature and taxonomy		<ul style="list-style-type: none"> • Plants in medicine • The origin of pharmacognosy • The scope and practice of pharmacognosy • Plant nomenclature and Taxonomy <ul style="list-style-type: none"> ➤ Herbarium, Collection methods, Field equipments, Technique to press the specimens, Importance, of herbarium, Some major herbaria of the world ➤ Importance of plant taxonomy in pharmacognosy
2.	The Plant and Animal Kingdoms as Sources of Drugs	13	
	Biological and geographical sources of drugs, A taxonomic approach to the study of medicinal plants and animal derived drugs, Pharmacological activities of natural products, Synergy in relation to the pharmacological action of phytomedicinals		<ul style="list-style-type: none"> • Biological and geographical source of drugs • Types of Plant Classification • A taxonomic approach to the study of the medicinal plants and animal derived drugs <ul style="list-style-type: none"> ➤ Thallophytes (Bacteria, Algae, Fungi, Lichens) ➤ Bryophyta ➤ Pteridophyta • Gymnosperm (Cycadales, Ginkgoales, Coniferales, Taxales, Gnetales) • Angiosperms: Dicotyledons Sub-class- Archichlamydeae (Only highlighted sub classes will be taught in detail) <ul style="list-style-type: none"> ▪ Juglandales 2 families ▪ Salicales 1 family ▪ Fagales 2 families

			<ul style="list-style-type: none"> ▪ Urticales 4 families ▪ Proteales 1 family ▪ Santalales 3 families ▪ Polygonales 1 family ▪ Centrospermae 3 families ▪ Cactales 1 family ▪ Magnoliales 10 families ▪ Ranunculales 4 families ▪ Piperales 1 family ▪ Aristolochiales 1 family ▪ Guttiferales 4 families ▪ Sarraceniales 3 families ▪ Papaverales 4 families ▪ Rosales 6 families ▪ Geraniales 5 families ▪ Rutales 6 families ▪ Sapindales 4 families ▪ Celastrales 3 families ▪ Rhamnales 2 families ▪ Malvales 5 families ▪ Thymelaeales 2 families ▪ Violales 8 families ▪ Curcurbiatales 1 family ▪ Myrtiflorae 6 families ▪ Umbelliflorae 5 family <p>Sub-class- Sympetalae</p> <ul style="list-style-type: none"> ▪ Ericales 1 family ▪ Primulales 2 family ▪ Plumbaginales 1 family ▪ Ebenales 3 families ▪ Oleales 1 family ▪ Gentianales 6 families ▪ Tubiflorae 12 families ▪ Pentaginales 1 family ▪ Dipsacales 3 families ▪ Campanulales 2 families <p>Angiosperms: Monocotyledons</p> <ul style="list-style-type: none"> ▪ Liliflorae 6 families ▪ Bromeliales 1 family ▪ Graminales 1 family ▪ Principles 1 family ▪ Spathiflorae 1 family ▪ Cyperales 1 family ▪ Scitamineae 4 families
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		<ul style="list-style-type: none"> ▪ Microspermae 1 family <p>Animal Products</p> <ul style="list-style-type: none"> ➤ Protozoa ➤ Porifera ➤ Coelenterate ➤ Platyhemninthis ➤ Nematode ➤ Mollusca ➤ Annelida ➤ Arthropoda ➤ Chordata <p>Pharmacological activities of natural product</p> <ul style="list-style-type: none"> ➤ Drugs acting on the nervous system ➤ The heart, circulation and blood ➤ Action on the gastrointestinal tract ➤ The nasal and respiratory system ➤ The liver ➤ The urinary and reproductive system ➤ The skin and mucous membrane ➤ Action on sugar metabolism ➤ Anti-inflammatory drugs ➤ Treatment of infection ➤ Treatment of maliganant disease ➤ Treatment of allergies ➤ The immune system ➤ Vitamins <p>Synergy in relation to the pharmacological action of phytomedicinals</p> <ul style="list-style-type: none"> ➤ What is synergy? ➤ Measuring synergy ➤ Synergy and polyvalent action in phytomedicine ➤ Enhancement activity- single herb extract and multiple herb extract ➤ Attenuation of toxicity ➤ Other miscellaneous synergistic interactions
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3.	Principles Related to the Commercial Production, Quality and Standardization of Natural Products	12	Introduction only
	Commerce in crude drugs, Production of crude drugs, Plant growth regulators, Plant cells and tissue culture, Phytochemical variation within a species, Deterioration of stored drugs, Quality control		<p>Commerce in crude drugs</p> <ul style="list-style-type: none"> ➤ Historical development ➤ Current aspect ➤ Challenging demands ➤ The future <p>Production of crude drugs</p> <ul style="list-style-type: none"> ➤ Environmental conditions ➤ Cultivated and wild plants ➤ Collection ➤ Drying ➤ Storage <p>Plant growth regulators</p> <ul style="list-style-type: none"> ➤ Auxins ➤ Gibberellins ➤ Cytokinin ➤ Ethylene <p>Plant cells and tissue culture</p> <ul style="list-style-type: none"> ➤ Steps in micropropagation ➤ Importance of micropropagation in pharmacognosy ➤ Somatic hybridization ➤ Industrial significance ➤ Cultivation of plant cell ➤ Production of secondary metabolites ➤ Induced secondary metabolism in cell culture ➤ Biological conversion by plant cell culture ➤ Immobilized plant cells ➤ Organ culture ➤ Clonal propagation <p>Phytochemical variations within the species</p> <ul style="list-style-type: none"> ➤ Chemical races, chemodemes ➤ Changes in chromosome number ➤ Artificial production of mutation

			<ul style="list-style-type: none"> ➤ Hybridization ➤ Transgenic medicinal plants <p>Deterioration of stored drugs</p> <ul style="list-style-type: none"> ➤ Primary factors ➤ Mould and bacterial attacks ➤ Coleopteran or beetles ➤ Lipidoptera ➤ Arachnida ➤ Control of infestation ➤ Spoilage by rodents <p>Quality control</p> <ul style="list-style-type: none"> ➤ Standard application to crude drugs ➤ Standard application to volatile and fixed oils ➤ Assays
4.	Some Current Trends	6	Introduction only
	Plant products and High Throughput Screening, Biologically active compounds from marine organisms, Traditional plant medicines as a source of new drugs		<p>Plant products and High Throughput Screening</p> <ul style="list-style-type: none"> ➤ Traditional and orthodox medicine ➤ High throughput screening as a route of discovering new medicine in the pharmaceutical industries ➤ Access to plant and other natural source materials ➤ Dereplication and isolation of active components <p>Biologically active compounds from marine organisms</p> <ul style="list-style-type: none"> ➤ Introduction ➤ Classes of active compounds <ul style="list-style-type: none"> ▪ Antiviral substances ▪ Cytotoxic compounds ▪ Antiparasitic compounds ▪ Anticoagulants ▪ Antimicrobial agents ▪ Anti-inflammatory compounds ▪ Prostaglandins ▪ Proteins ▪ Agrochemical use ▪ Dinoflagellate and diatom

			<p>derived shellfish poisoning</p> <ul style="list-style-type: none"> ▪ Toxins <p>Traditional plant medicines as a source of new drugs</p> <ul style="list-style-type: none"> ➤ Definition ➤ Historical dimension ➤ The process of modern drug discovery using ethno pharmacological ➤ Some modern examples of drug discovery based on the ethno pharmacological approach ➤ The value of ethno pharmacological approach ➤ Problems with the ethno pharmacological approach
5.	Medicinal Plants of Nepal	10	
	Simple method of Identification, Nomenclature, Common medicinal uses, and Commercial value of at least 30 medicinal plants found in Nepal		<ol style="list-style-type: none"> 1. <i>Ocimum sanctum</i> (tulsi) 2. <i>Azadirachata indica</i> (Neem) 3. <i>Justice adhatoda</i> (Asuro) 4. <i>Aconitum spicatum</i> (bikh) 5. <i>Rauwolfia serpentine</i> (sarpagandha) 6. <i>Acorus calamus</i> (bojho) 7. <i>Terminalia chebula</i> (Harro) 8. <i>Terminalia bellirica</i> (Barro) 9. <i>Phyllanthus emblica</i> (Amala) 10. <i>Asparagus racemosus</i> (kurilo) 11. <i>Swertia chirayita</i> (chirayito) 12. <i>Rubia manjith</i> (majitho) 13. <i>Oroxylum indicum</i> (tatelo) 14. <i>Camellia sinensis</i> (Green tea) 15. <i>Allium sativum</i> (lasun) 16. <i>Urtica dioica</i> (Sisno) 17. <i>Crataeva nurvala</i> (siplican)

			<p>18. <i>Bauhinia veriegata</i> (Koiralo) 19. <i>Picrorhiza scrophulariflora</i> (Kutki) 20. <i>Rheum austral</i> (Padamchal) 21. <i>Momordica charantia</i> (Tita karala) 22. <i>Lilium nepalense</i> (Ban Lasoon) 23. <i>Juglans regia</i> (okhar) 24. <i>Dactylorhiza hatagirea</i> (panch aunle) 25. <i>Centella asiatica</i> (ghod taprae) 26. <i>Cassia fistula</i> (rajbriksha) 27. <i>Cannabis sativa</i> (Ganga) 28. <i>Allo vera</i> (Ghu kumari) 29. <i>Codycep sinensis</i> (yarsagumba) 30. <i>Jingiber officinale</i> (Aduwa)</p>
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Reference Books:

1. W. C. Evans: Trease and Evans Pharmacognosy, 2002, W. B. Saunders, Harcourt Publisher Limited, London.
2. T. E. Wallis: Text Book of Pharmacognosy, (5th Ed., 1997), CBS Publisher and Distributors, New Delhi.
3. N. P. Manandhar: People and Plants of Nepal, Timber Press, Portland, USA.
4. O. P. Sharma: Plant taxonomy, 1993, Tata-McGraw Hill Publishing Company, New Delhi.
5. Eames: An Introduction to Plant Anatomy, 1997, Tata-McGraw Hill Publishing Company, New Delhi.

MTH 194 (Credit hours 3)**Biostatistics**

B. Pharm., First Year, Second Semester

Course Objectives:

The student would be able to understand the terminology of statistics and able to read and present pharmaceutical data in the tabular and graphic form, calculate and understand the application of test of significance.

Unit	Course Description	Hours	Details	Suggestions
1.	Introduction	4		
	Definition, Scope and limitations, Sources of data, Techniques of collecting primary data, General concepts of sampling			
2.	Classification and Presentation of Data	6		
	Data classification (need, objectives, and types of data collection), Construction of frequency and relative frequency distribution and its principles, Tabular presentation, Diagrammatic presentation (Bar and Pie diagram), Graphic presentation (Histogram, Frequency polygon, Ogive), Stem and leaf display presentation			
3.	Fundamental Statistical Measures	8		
	Measures of central tendency (Mean, Median, Mode, Weighted Average and Geometric mean), Measures of dispersion (Range, Quartile deviation, Standard deviation, Coefficient of variation)			
4.	Probability Theory	6		
	Concept and Importance, Types of events, Objective and subjective probabilities, Marginal and joint probabilities, Theorems of probability, Conditional			

	probability, Mathematical expectation			
5.	Probability Distribution	7		
	Discrete probability distribution (Binomial and poisson distribution and mean of their distributions), Continuous probability distributions, Normal distribution, Normal approximation of Binomial distributions			
6.	Test of Significance	8		
	Test of significance (<i>t</i> -test, Z-test, χ^2 -test), Computational procedure of hypothesis testing, Hypothesis testing when population S.D. is known, Hypothesis testing when population S.D. is unknown			
7.	Simple Correlation and Regression Analysis	6		
	Scatter diagram, Correlation, Least square regression, Prediction and Confidence internals for estimating regression parameters			Prediction and Confidence internals for estimating regression parameters is not preferred to be taught here as estimation is not priority taught

Reference Books:

1. B. K. Mahajan: *Methods in Biostatistics* (6th Ed.) 1999, Jaypee Brothers, Medical Publishers (P) Ltd., New Delhi.
2. Jit S. Chandan: *Statistics*, 1999, Vikash Publishing House, Pvt. Ltd., New Delhi.

LAB-2 (Credit hour 1)

Pharmaceutical Laboratory-2

B. Pharm., First Year, Second Semester

Course Objectives: *Introduction to basic operations in Pharmaceutics*

Course Contents:

1. Pharmaceutical dilutions and calculations
2. Preparation of isotonic solution
3. Preparation of buffer and its stability
4. Coacervation
5. Preparation of colloidal systems
6. Particle size analysis

Reference Books:

1. Sheila J. Ogden: Calculation of Drug Dosages (7th Ed.) 2003, Mosby, St. Luis.

LAB-3 (Credit hour 1)

Pharmaceutical Laboratory-3 B. Pharm., First Year, Second Semester

Course Objectives: *Introduction to Pharmaceutical Chemistry*

Course Contents:

1. One step preparation of compounds of medicinal properties
2. Assay of pharmaceutical compounds based on acid-base, oxidation-reduction, precipitation and diazotization titration
3. Preparation of complexes and complexometric titration
4. Gravimetric determination of official compounds and detection of metal ions

Reference Books:

1. John McMurry and Mary E. Castellion: *Fundamentals of General, Organic and Biological Chemistry* (2nd Ed.) 1996, Prentice Hall Inc., New Jersey.
2. A. H. Beckett and J. B. Stenlake: *Practical Pharmaceutical Chemistry* (4th Ed.) 2000, CBC Publishers and Distributors, New Delhi.

LAB-4 (Credit hour 1)

Pharmaceutical Laboratory-4
B. Pharm., First Year, Second Semester

Course Objectives: *Introduction to Pharmacognosy*

Course Contents:

1. Preparation of Herbarium (at least 20 samples)
2. Collection of crude drugs (at least 20 samples)
3. Crude identification by physical appearance and microscopic studies (at least 20 samples)
4. Preparation of report on a particular natural medicine
5. Quality control: Extractive value, ash value, moisture contents
6. Extraction of Ten crude drugs
7. TLC pattern of Ten crude drugs

SEM-1(Credit hour 1)

Pharmaceutical Seminar-1

SECOND YEAR

THIRD SEMESTER

SECOND YEAR

THIRD SEMESTER

Code	Description	Credit hours	Pre-requisite course	Core Course
PHT 201	Pharmaceutics III (Dosage forms and Formulations)	3	PHT 102	☼
BCM 221	Biochemistry II	3	BCM 121	
APL 231	Anatomy and Physiology II	3	APL 131	
CBL 241	Molecular Cell Biology (Genetic Engineering)	3	.....	.....
PHC 271	Pharmaceutical Chemistry IV (Analytical Chemistry)	3	.....	☼
PHG 281	Pharmacognosy II (Spectroscopy)	3	PHC 172	☼
LAB-5	Pharmaceutical Laboratory 5	1	.....	.....
LAB-6	Pharmaceutical Laboratory 6	1	.....	.....
LAB-7	Pharmaceutical Laboratory 7	1	.....	.....
SEM-2	Pharmaceutical Seminar-2	1	.....	.....
TOTAL		22		

PHT 201(Credit hours 3)

Pharmaceutics III (Dosage Forms and Formulations A)

B Pharm., Second Year, Third Semester.

Course Objectives:

The students will become familiar with the commonly administered dosage forms, their characteristics and preparations methods, which shall provide a broad view of pharmaceuticals.

Unit	Course Description	Hrs.	Details
1	<p>Dosage Forms Design General considerations, Pharmaceutical ingredients, Current Good Manufacturing Practice, Packaging</p>	4	<p>GENERAL CONSIDERATION IN DOSE DESIGN Preformulation Studies, Physical description , Microscopic examination Melting point depression , Phase rule ,Particle size Polymorphism ,Solubility ,Solubility and particle size Solubility and pH ,Dissolution ,Membrane permeability ,Partition coefficient PKaDissociation constant Drug and drug product stability Drug stability and mechanism of degradation Drug and drug product stability kinetic and self life Chemical Physical Microbiological Therapeutically Toxicological Rate reaction (with simple numerical) Zero order,First order,Second order Self life estimation (eg Q 10 method) Increasing Drug Products Stability Pharmaceutical ingredients Examples of pharmaceutical ingredients More detail about mainly used pharmaceutical ingredients Current Good Manufacturing Practice About WHO GMP, National GMP and cGMP Components of WHO GMP Packaging Packaging concept,Importance of packaging Packaging material, Types of packaging Possible packaging defaults</p>

2	<p>Solid Dosage Forms for Oral Administration Powders, Granules, Granulation, Tablets, Capsules, Rate-controlled dosage forms, Drug delivery systems, Packaging</p>	12	<p>About Powder and Granules Advantage and disadvantage ,Particle size and analysis ,Particle size influence ,Determination of particle size, Size reduction ,Type of powder About granulation and reason for granulation Method used for granulation ,Effervescent granulated salts Capsule :Type of capsule , Hard gelatin capsule (manufacture, preparation of hard gelatin capsule, about capsule filling machine, advantage and disadvantage of this dosage form) ,Soft Gelatin Capsule (preparation, utilization and etc) , Compendial Requirements for Capsules Tablets (different type with eg) Advantage and disadvantage ,Compendia requirements ,Tablet manufacture (from granulation to tablet coating , imprinting and polishing) Modified-release dosage forms and drug delivery systems Advantage and disadvantage of control release Terminology (like modified release, repeat action targeted release , extended , delayed and etc) Drug candidates for modified or extended-release Different Technology used for Rate-controlled (Coated Beads Granules , Microspheres Multitabiet System, Microencapsulated, Drug Embedding, Drug in Inert Plastic Matrix , Complex Formation , Ion-Exchange Resins, Repeat Action Tablets Delayed-Release Oral Dosage Forms USP Requirement for MR Dosage Form:</p>
3	<p>Solutions, Syrups and Elixirs for Oral Administration Solubility, Solutions, Syrups, Elixirs, Packaging</p>	6	<p>Solution, type of solution Solubility Some solvent used for liquid preparation (<u>ALCOHOL, USP (ETHYL ALCOHOL, ETHANOL, C₂H₅OH), DILUTED ALCOHOL, NF, ALCOHOL, RUBBINGPURIFIED WATER, USP (H₂O)</u>)</p>

			<p><i>AND ETC)</i></p> <p>Preparation of solutions (like oral rehydration solutions, oral colonic levage solution, magnesium citrate oral solution and etc)</p> <p>Syrup Components of syrups ,Preparation of syrups</p> <p>Elixirs, Preparation of elixirs Tinctures, Method of extraction</p>
4	<p>Dispersed Systems for Oral Administration</p> <p>Oral suspensions, Rheology, Emulsions, Colloidal dispersions, Magmas and gels, Packaging</p>	8	<p>Dispersed systems: dispersed phase and dispersing phase , Suspension and reason for preparation of suspension , Featured desired for suspension , Application of suspension , Sedimentation Concept and sedimentation of suspension</p> <p>Physical feature of dispersed phase and dispermedium of suspension</p> <p>Rheological behavior, types of flow,Measurement of viscosity,Preparation of suspensions, Stability of suspensions, Types of suspensions(according to the route of administration, nature of dispersed phase , methods of preparation and according to nature of sediment)</p> <p>Packing, labeling and storage requirements of suspension</p> <p>Emulsion , Purpose of emulsion and emulsification</p> <p><i>Theories of emulsification, HLB SYSTEM and HLB value , Methods of emulsion preparation, Type of emulsion , Stability of emulsions, Example of some oral emulsion</i></p> <p>Colloidal dispersions including <i>lyophilic colloids, lyophobic colloids and amphiphilic colloids</i></p> <p>Gels and Magmas, Terminology related to gels, Yypes of gels.,Preparation of magmas and gels</p> <p><i>Some example of gel and gelling agents</i></p> <p>Proper administartion and use of disperse systems</p>
5	<p>Parenteral Medications and Sterile Fluids</p> <p>Parenteral routes of administration, Injections, Methods of sterilization,</p>	12	<p>Parenterals, when parental undertaken</p> <p><i>Parenteral routes of administration, Advantage and disadvantage of Parenteral, PCA and its advantage</i></p>

	Pyrogens and pyrogen testing, Industrial manufacturing, Packaging, Quality assurance system, Large volume parenterals, Biologicals, Pellets or implants, Irrigation solutions, Dialysis solutions		<p><i>IV, IM, SC , Intradermal and specialized access</i></p> <p><i>Official types of injections, Solvents and vehicles for injections (nonaqueous vehicles and added substances)</i></p> <p><i>Sterilization</i> , Methods of sterilization</p> <p><i>Validation – overview</i></p> <p><i>Pyrogens</i>, <i>Pyrogen testing, Industrial preparation of parenteral preparations, Packaging, labeling and storage of injections</i></p> <p><i>Quality assurance for pharmacy-prepared sterile products</i></p> <p>Small Volume Parenterals (SVP) , Problem with this formulation , Insulin and its type</p> <p>Large Volume Parenterals (Lvp)</p> <p>Maintenance therapy</p> <p>Replacement therapy</p> <p>Electrolyte requirement</p> <p>Caloric requirements</p> <p>Special considerations associated with parenteral therapy</p> <p>Other injectable products – pellets and implants</p> <p>Levonorgestrel implant contraceptive system</p> <p>Irrigation and Dialysis solutions</p>
6	Miscellaneous Preparations Crude drugs, Tinctures, Fluid extracts, Extracts, Aromatic waters, Spirits, Effervescent salts, Divided powders, Packaging	3	Crude drugs, Tinctures, Fluid extracts, Extracts, Aromatic waters, Spirits, Effervescent salts, Divided powders, Packaging

Reference Books:

1. Howard C. Ansel, Loyd V. Allen and Nicholas G. Popovich: *Pharmaceutical Dosage Forms and Drug*
2. *Delivery System* (7th Ed.) 1999, Lippincott Williams and Wilkins, Philadelphia.
3. Michael E. Aulton (Ed.): *Pharmaceutics, The Science of Dosage Form Design*, 1999, Churchill Livingstone, International Student Edition, New Delhi.
4. E. A. Rowlin (Ed.): Bentley's The Textbook of Pharmaceutics (8th Ed.) 2001, Bailliere Tindall, London.
5. 4. R. Gennaro (Ed.): *Remington's Pharmaceutical Sciences* (18th Ed.) **1990, Mack Publishing Company**, Easton.

BCM 221 (Credit hours 3)**Biochemistry II****B. Pharm, Second Year, Third Semester****Course Objectives:**

This course will provide a basic knowledge on vitamins, hormones and enzymes and their application in pharmaceutical sciences

Unit	Course Description	Hrs.	Details
1	Vitamins Chemistry, Physiological functions, Deficiency symptoms, Sources, Requirements and therapeutic uses of the following vitamins: vitamin A, vitamin D, vitamin K, vitamin E and C, and vitamins of B group, (i.e. thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, lipoic acid, biotin, inositol, paraaminobenzoic acid, folic acid, vitamin B12)	18	Vitamin A has a function in vision .Night blindness. Vit D is generated from the provitamin Dehydrocholesterol by the action of sunlight Active fat absorption promotes the absorption of vit E Vit E is most important natural antioxidant Mechanism of vitamin K1 dependent carboxylation Vitamin K cycle allows reduced vitamins k to be regenerated Thiamin diphosphate is a coenzyme in enzymatic reactions in which activated aldehyde unit is transferred Beriberi. Pyridoxal phosphate is the coenzyme of several enzymes of amino acid metabolism Deficiency of Vitamin B12 leads to megaloblastic anemia Biotin is the coenzyme of carboxylase enzymes Folate deficiency causes megaloblastic anemia.
2	Hormones Chemistry, Mechanism of action, Biosynthesis, Release, Metabolic function and therapeutic uses of the following hormones: insulin, glucagon, thyroxine, parathormone, adrenaline, noradrenaline, corticosteroids, sex hormones, hormones of hypophysis, hypothalamic regulating factors and hormone antagonists.	17	Introduction, Classification of hormones, chemical structure and mechanism of action. Hormone receptors and their activation. Insulin: Pancreas and its secretion, chemistry of Insulin, activation of target cell receptors by insulin and the resulting cellular effects, Metabolic functions of Insulin, Therapeutic uses of insulin Glucagon- structure, secretion,

			<p>metabolic effects, therapeutic uses.</p> <p>Thyroxine- Thyroid gland and secretion, Chemistry, thyroid hormone biosynthesis involves thyroglobulin and iodide metabolism, physiologic functions of thyroid hormones, diseases of thyroid.</p> <p>Hormones of adrenal medulla- adrenal medulla, synthesis of epinephrine and norepinephrine, Functions of epinephrine and norepinephrine, diseases in adrenal medulla.</p> <p>Hormones of gonads- Gonads, Testes produce spermatozoa and testosterone, pathways of testosterone pathways, dihydrotestosterone is formed from testosterone in peripheral tissues, Biosynthesis of estrogens, Hormonal effects of gonadal estrogens, testosterone, progesterone, Hypogonadism, hypergonadism in male, Abnormalities of secretion of ovaries.</p> <p>Hormones of Hypophysis- Pituitary gland, Hormones produced by anterior and posterior pituitary, Anterior pituitary gland contain different cell types that synthesize and secrete hormones, Hypothalamic releasing and inhibitory hormone that control secretion of anterior pituitary gland.</p> <p>Hormones of anterior pituitary Growth hormone: physiologic functions, Hypersecretion and hyposecretion, Thyroid stimulating hormone, ACTH, FSH, Prolactin.</p> <p>Hormones of posterior pituitary Oxytocin, Vasopressin.</p>
3	Enzymes General properties, Classification, Factors influencing enzyme action, Kinetics,	10	Defination of Enzymes, General properties of Enzymes, Types of Enzyme, Factors affecting enzyme

	<p>Michalis-Menten equation, Lineweaver-Burk plot, Inhibitors and activators, competitive and noncompetitive inhibitor, Regulation of enzyme activity.</p>	<p>action, Kinetics, Michaelis-Menten Kinetics: accounts for the kinetic properties of many enzymes and the significance of Michael-Menten kinetics, Lineweaver burk plot. Inhibitors- Competitive Inhibition (CompetitiveInhibitors as chemotherapeutic agents , Non-competitive inhibition with examples, enzyme regulation.</p>
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Reference Books:

1. Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W: Rodwell: *Harper's Biochemistry* (25th Ed.)
2. 2000 Appleton and Lange, Stamford.
3. Lubert Styrer: *Biochemistry* (4th Ed.) 2000, W. H. Freeman and Company, New York.
4. David L. Nelson and Michel M. Cox: *Lehninger's Principles of Biochemistry* (3rd Ed.) 2000, Macmillan Worth Publisher, New York

APL 231 (Credit hours 3)**Anatomy and Physiology II**
B. Pharm., Second Year, Third Semester**Course Objectives:**

This course will provide the basic knowledge on the structure and function of human body, which will enable the students to understand scientific basis of drug action.

	Course Description	Hrs.	Details
1	Respiratory System A general introduction and physiological anatomy of respiratory system, Pulmonary ventilation, Mechanism of respiration, Volume and capacities, Gaseous exchange, Transport of gases, Regulation of respiration	10	Physiologic peculiarities of specific pulmonary abnormalities like emphysema, pneumonia, atelectasis, asthma, TB. Knowledge of hypoxia and oxygen therapy with hypercapnia.
2	Nervous System Protection and coverings, Cerebrospinal fluid, Blood supply, Brain stem, Diencephalon, Cerebrum, Brain waves, Cerebellum, Cranial nerves, Homeostatic imbalances of the central nervous system	12	Upper and lower motor fibres, motor and integrative neurophysiology including spinal cord and cord reflexes, introduction to special senses and higher functions of the brain like behaviour, motivation, learning and memory Homeostatic imbalances - Encephalitis, meningitis, upper motor lesion, lower motor lesion, hemiplegia and paraplegia
3	Circulatory System Introduction, Anatomy of heart, Conduction system of heart, Nervous regulation of heart, Coronary circulation, Cardiac cycle, Blood pressure, Heart rate cardiac output and homeostatic imbalances of the cardiovascular	10	homeostatic imbalances- IHD/MI/Hypertension/ atherosclerosis/ Heart failure/ Arrhythmia
4	Endocrinology and Reproduction An introduction to endocrinology. Male and female reproductive organs. Male and female sex hormones. Mechanism of hormonal action, Endocrine regulation, The pituitary hormones and their control by the hypothalamus. The thyroid metabolic hormones, The adrenal hormones. Homeostatic imbalances of the above mentioned hormones. Reproductive functions of the male and female sex hormones, Menstrual cycle	13	Acromegaly, Gigantism, hyperthyroidism, hypothyroidism, acute adrenal insufficiency, HPA suppression, IDDM & NIDDM, hyper & hypoparathyroidism

Reference Books:

1. Peter L. Williams et al. (Ed.): *Gray's Anatomy*, (38th Ed.) 1995, Churchill Livingstone, New York.
2. Chummy S. Sinnatamby: *Last's Anatomy Regional and Applied*, 1999, Churchill Livingstone, New York.
3. Arthur C. Guyton and John E. Hall: *Guyton Human Physiology and Mechanisms of Disease*, 1996, Harcourt Publishers Limited, Singapore

CBL 241 (Credit hours 3)

**Molecular Cell Biology
(Genetic Engineering)
B. Pharm., Second Year, Third Semester**

Course Objectives:

This course is designed to explain the general principles of genetic engineering and its application to pharmaceuticals.

Unit	Course Description	Hrs.	Details
1	Fundamental Terminology DNA, RNA, Nucleotides, Nucleosides, tRNA, mRNA, Translation, Transcription, Genes	3	Purine and pyrimidine bases, DNA, RNA, Nucleotides, Nucleosides, tRNA, mRNA (brief introduction along with the structures); Translation, Transcription, Genes, Genome (brief introduction along with figures).
2	RNA and Protein Synthesis Process of DNA transcription, The promoter sequence, Translation of nucleotide sequence into protein sequence, Specific enzyme copulation, Addition of amino acids to the carboxyl terminal end, Degeneration of genetic code, Protein synthesis in ribosome, Release of a protein chain from ribosome, The reading frame for protein synthesis, Protein synthesis in eucaryotes and procaryotes	8	DNA transcription, The promoter sequence, Start and stop signals, Translation of nucleotide sequence into protein sequence, Specific enzyme copulation, Addition of amino acids to the carboxyl terminal end, Degeneration of genetic code, Protein synthesis in ribosome, Release of a protein chain from ribosome, Proof reading mechanism during protein synthesis, The reading frame for protein synthesis, Protein synthesis in eucaryotes and prokaryotes, Polyribosomes, Protein synthesis inhibitors (Figures are compulsory).
3	DNA Repair Mechanism DNA sequence maintenance, Mutation rate and its importance, Stability of genes and DNA repair, Recognition of DNA damage	4	DNA sequence maintenance, Mutation, Mutation rate and its importance, Determination of mutation rate, Causes of DNA damage, Stability of genes and DNA repair, Recognition of DNA damage (Figures are compulsory).
4	DNA Replication Mechanism DNA replication, Proof reading mechanism, DNA replication in the 5' to 3', DNA primers, DNA helicases, DNA primase, Mismatch proof reading, Replication origins, DNA topoisomerase, DNA replication in eucaryotes and procaryotes	6	DNA replication, Proof reading mechanism, DNA replication in the 5' to 3', DNA primers, DNA helicases, DNA primase, Mismatch proof reading, Replication origins, DNA topoisomerase, DNA replication in eucaryotes and prokaryotes (Figures are compulsory).

5	Genetic Recombination Mechanism Genetic recombination, General recombination, DNA renaturation (hybridization), recA protein, Branch migration, Cross-Strand exchange, Gene conversion, Site-specific genetic recombination	6	Genetic recombination, General recombination, DNA renaturation (hybridization), recA protein, Branch migration, Cross-Strand exchange, Gene conversion, Site-specific genetic recombination (Figures are compulsory).
6	Virus, Plasmids and Transposable Genetic Elements Viral genomes, RNA virus, DNA virus, Provirus, Retrovirus, Reverse transcriptase, Plasmids	6	Viral genomes, RNA virus, DNA virus, Provirus, Retrovirus, Reverse transcriptase, Transposable elements, Plasmids (Figures are compulsory).
7	DNA Cloning and Genetic Engineering Restriction Nucleases, DNA library, Plasmid vectors, Genomic DNA cline, cDNA, Subtractive hybridization, Chromosome walking, Hybrid selection, Expression vectors, Design of genes, Insertion of engineered genes, Transgenic animal, PCR, Mapping and analysis of large genomes	10	Restriction Nucleases, DNA library, Plasmid vectors, Genomic DNA cline, cDNA, Subtractive hybridization, Chromosome walking, Hybrid selection, Expression vectors, Design of genes, Insertion of engineered genes, Transgenic animal, PCR, Mapping and analysis of large genomes (Figures are compulsory).
8	Use of Genetic Engineering in Pharmaceutical Sciences Production of commercial insulin from <i>E. Coli</i>	2	Production of commercial insulin from <i>E. Coli</i> (Figures are compulsory).

Reference Books:

1. Bruce Albert, Dennis, Bray, Julians Lewis, Martin Raff, Keith Roberts and James D. Watson: *Molecular Biology of the Cell* (2nd Ed.) 1989, Garland Publishing, Inc, New York.
2. James Darnell, Harvey Lodish and David Baltimore: *Molecular Cell Biology* (2nd Ed.) 1990, Scientific American Books, New York

PHC 271 (Credit hours 3)

**Pharmaceutical Chemistry IV
(Analytical Chemistry)**

B. Pharm., Second Year, Third Semester

Course Objectives: *This course is designed to explain the general principles of instrumental analysis techniques and their application in pharmaceutical products.*

Unit	Course Description	Hr	Details
1	An Introduction to Analytical Methods Classification of analytical methods, Types of instrumental methods, Instruments for analysis, Selection of analytical methods, Calibration of instrumental methods	5	Classification of analytical Methods Definition and scope and importance is analytical Chemistry? Qualitative and quantitative with examples Classical and Instrumental With Examples Types of Instrumental Methods Brief Introduction and examples relating to Spectroscopic techniques, Electrochemical techniques, Gravimetry, Thermal Analysis, Kinetic techniques, Mass Spectrometry, Chromatographic techniques Instruments for analysis Introduction Data domains and their classification Detectors, Transducers and Sensors Selection of analytical methods Steps followed for analytical determinations Choosing a analytical method Performance Characteristics of Instruments- Brief Errors Calibration of Instrumental Methods Comparison with standards Calibration Curves Internal Standard Methods Standard Addition Methods
2	An Introduction to Spectrometric Methods Wave properties of electromagnetic radiation, Quantum-mechanical properties of radiation, Component of optical instrument	5	Electromagnetic Radiation Introduction General Properties Wave Properties (Characteristic behavior of an electromagnetic wave) Introduction of Electromagnetic Spectrum Mathematical Description of a Wave Superposition of Waves- Constructive and Destructive Definition and brief introduction to

		<p>diffraction, coherent radiation, Transmission and Scattering of radiation, Refraction, Reflection, Polarization</p> <p>Quantum Mechanical Properties of Radiation</p> <p>Introduction to photons Photoelectric Effect Energy states of Chemical Species(atomic and molecular level) Ground State and Excited State Electronic, Vibrational and Rotational States- definition Emission of Radiation- Introduction to Line, Band and Continnum Spectra Absorption of Radiation- General Introduction Relaxation Process- in brief Beer's Law</p> <p>Components of Optical Instruments</p> <p>General Design of Optical Instruments Sources of Radiation-Line and Continnum Laser Source- Components, Mechanism Wavelength Selectors- Filters and Monochromators (Introduction and Examples) Sample Containers Radiation Transducers- Introduction and examples(no description) Signal Processors and Readouts- Introduction and examples (no description) Types of Optical Instruments- names and definitions</p>
3	<p>Atomic Absorption and Fluorescence Spectrometry</p> <p>Sample atomization technique, Atomic absorption instrumentation, Atomic absorption analytical technique, Atomic fluorescence spectroscopy</p>	5 <p>Sample Atomization Technique</p> <p>Atomization and it's processes Flame Atomization- types of flame, flame structure, flame atomizers Electrothermal Atomization Specialized Atomization- glow discharge, hydride and cold vapor</p> <p>Atomic Absorption Instrumentation</p> <p>Radiation source- hollow cathode lamp and electrodeless discharge lamp Spectrophotometers- Single beam and double beam Interferences- Spectral, Background,</p>

			<p>Chemical and Physical and their minimization</p> <p>Atomic absorption analytical technique Sample preparation Sample delivery Nebulization Calibration and Interpretation of Results Applications</p> <p>Atomic Fluorescence Spectroscopy Instrumentation, Interferences and Application</p>
4	<p>Atomic Emission Spectrometry Emission spectroscopy based on plasma source, Emission spectroscopy based on arc and spark sources, Miscellaneous sources for optical emission spectroscopy</p>	5	<p>Emission Spectroscopy based on Plasma Sources Instrumentation Sample devices and delivery Plasma Characteristics Inductively Coupled Plasma Source Direct Current Plasma Source Interferences in Plasma Sources Application of Plasma sources</p> <p>Emission Spectroscopy based on arc and spark sources Sample types and handling Arc Source Emission Spectroscopy Spark sources and spark spectra</p> <p>Miscellaneous sources for optical emission spectroscopy Flame emission sources, glow discharge sources, laser sources</p>
5	<p>Flame Photometry Principles of flame photometry, Inferences in flame photometry, Evaluation method in flame photometry,</p>	5	<p>Principle of flame photometry Basic principle Instrumentation Sample preparation and delivery Interferences in flame photometry Evaluation of results Applications of flame photometry</p>
6	<p>Polarimetry Polarised light, Application of polarimetry, Optical rotatory dispersion (ORD) and circular dichroism (CD), Principles and instrumentation for ORD and CD</p>	5	<p>Polarized light, Optical Activity, Specific Rotation Principle and Instrumentation of polarimeter Applications of Polarimetry Linearly and circularly polarized light Circular birefringence, Optical Rotatory Dispersion and Circular Dichromism</p>

			Cotton Effect Instrumentation and Applications of CD and ORD
7	Potentiometry Electrochemical cells, Electrode potential, Standard electrode potential, Various electrodes in potentiometry, Instrumentation, Potentiometric titration, Potentiometry in quantitative analysis	5	Introduction – cathode, anode, oxidation, reduction Electrochemical cells General principles Charge transfer in electrochemical cells Types of electrochemical cells-galvanic and electrolytic Nernst Equation Electrode potential- half cell potential, cell potential, cell representation Various electrodes in potentiometry Reference electrodes- Standard Hydrogen Electrode, Calomel Reference electrode, silver- silver chloride reference electrode Indicator electrodes- metallic (and its types), membrane (examples of), glass electrode Instrumentation for measuring cell potentials-potentiometer, electronic voltmeter Different types of potentiometric titrations-introduction and examples Applications of potentiometry
8	Polarography and Voltammetry Principles, Instrumentation, Application of polarography and voltammetry	5	Excitation signals in voltammetry Voltammetry instrumentation Working Electrodes, Microelectrodes Voltammograms- basics Hydrodynamic voltammetry-instrumentation and applications Applications of Voltammetry Polarography Polarographic principle Instrumentation Activation potential, polarogram Diffusion limiting current and Ilkovic equation Polarogram and polarographic waves Concept of half wave potential Polarographic maxima Applications of polarography
9	Conductometry Principles, Instrumentation, Application	5	Definitions – Ohm's law, conductance, specific conductance, molecular

	of conductometry	conductance, equivalent conductance, resistance, specific resistance Effect of dilution on conductance parameters Requirements for conductance measurements Instrumentation for analysis and measurement- principle of wheatstone bridge Conductometric titrations Graphs and inferences of acid base conductometric titrations Applications of conductometry
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Reference Books:

1. Douglas A. Skoog, F. James Holler and Timothy A. Nieman: *Principles of Instrumental Analysis* (5th Ed.) 1998, Harcourt College Publisher (Harcourt Asia PTE Limited), Singapore.
2. S. M. Khopkar: *Basic Concept of Analytical Chemistry*, 1998, New Age International (P) Ltd. Publisher, New Delhi.

PHG 281 (Credit hours 3)

Pharmacognosy II
(Spectroscopy)
B. Pharm., Second Year, Third Semester

Course Objectives:

This course is designed to provide the knowledge on the basic theory and application of spectroscopic methods to elucidate the structure of organic molecules.

Unit	Course Description	Hrs.	Details
1	Energy and Electromagnetic Spectrum Units, The electromagnetic spectrum, Absorption of electromagnetic radiation by organic molecule	2	As it is
2	Ultraviolet-Visible Spectroscopy Colour and light absorption, The chromophore concept, Theory of electronic spectroscopy, Instrumentation and sampling, Solvent effect, Applications	6	As it is
3	Infrared Spectroscopy Unit of frequency, Wave length and wave number, Molecular vibration, Factors influencing vibrational frequencies, Instrumentation, Applications	5	As it is
4	Nuclear Magnetic Resonance Spectroscopy <i>Proton NMR Spectroscopy:</i> The NMR phenomenon, Theory of NMR, Instrumentation, Chemical shift and its measurement, Factors influencing chemical shift, Correlation data, Use of solvent, Integration, Spin-spin coupling, Factors influencing the coupling constant, Non-first-order spectra <i>Carbon-13 NMR Spectroscopy:</i> Natural abundance ¹³ C-NMR spectra, Structural application, Correlation data <i>Advanced techniques in NMR:</i> Spin-spin coupling and double irradiation, Internuclear double resonance, Selective population inversion, Nuclear Overhauser Effect, Variable-temperature NMR, Multipulse technique, DEPT, ¹ H- ¹ H-COSY, ¹ H- ¹³ C-COSY (HMQC), ¹ H- ¹ H-Long-range COSY(HMBC)	18	As it is
5	Mass Spectroscopy Basic principles, Instrumentation, Isotope abundances, Metastable ions, Fragmentation process, Fragmentation associated with functional groups, EI, CI, FD, FAB and GC-MS	8	As it is
6	X-ray analysis Basic principles, Instrumentation and application of X-ray methods in structure determination of organic molecules	6	As it is

Reference Books:

1. William Kemp: *Organic Spectroscopy* (3rd Ed.) 1991, Macmillan Press Ltd., London.
2. R. M. Silverstein, G. C. Baller and T. C. Morrill: *Spectrometric Identification of Organic Compounds*. (5th Ed.) 1991, John Wiley and Sons, Inc. London.
3. John R. Dyer: *Applications of Absorption Spectroscopy of Organic Compounds*, 1965, Prentice-Hall, Inc., London.

LAB-5 (Credit hour 1)

Pharmaceutical Laboratory-5 (Pharmaceutics)

B. Pharm., Second Year, Third Semester

Course Objectives: *The students will become familiar with the basic principles of manufacturing of drug dosage forms and formulations (A)*

Course Contents:

- | | |
|--|-------------------------|
| 1. Particle size analysis (applied to powders) | 2. Granulation |
| 3. Tablets | 4. Syrups and Elixiers |
| 5. Injections and Sterilization | 6. Crude drugs extracts |
| 7. Tinctures | 8. Divided powders |

Reference Books:

Japanese Pharmacopoeia XIII

LAB-6 (Credit hour 1)

Pharmaceutical Laboratory-6 (Spectral Analysis)

B. Pharm., Second Year, Third Semester

Course Objectives: *The students will become familiar with the basic principles of spectroscopy and able to identify small organic molecules with the help of UV, IR, NMR and mass spectra.*

Course Contents:

- | | |
|-----------------------|------------------------|
| 1. Use of UV spectra | 2. Use of IR spectra |
| 3. Use of NMR spectra | 4. Use of Mass spectra |
| 5. Use of X-ray data | |

Reference Books:

1. R. M. Silverstein, G. C. Baller and T. C. Morrill: *Spectrometric Identification of Organic Compounds* (5th Ed.) 1991, John Wiley and Sons Inc., London.
2. William Kemp: *Organic Spectroscopy* (3rd Ed.) 1991, Macmillian Press Ltd., London

LAB-7 (Credit hour 1)

Pharmaceutical Laboratory-7 (Quality Evaluation of Natural Drugs)

B. Pharm., Second Year, Third Semester

Course Objectives: *Student will learn general principle of extraction and isolation of some important crude drugs.*

Course Contents:

1. Quality control: Extractive value, ash value, moisture contents
2. Extraction of ten crude drugs
3. Extraction of essential oils
4. TLC pattern of ten crude drugs
5. Use of column chromatography

Reference Books:

1. Japanese Pharmacopoeia XIII
2. Indian Pharmacopoeia (1996)

SEM-2 (Credit hour 1)

Pharmaceutical Seminar-2

B. Pharm., Second Year, Third Semeste

Second Year

Fourth Semester

FOURTH SEMESTER

Code	Description	Credit hours	Pre-requisite course	Core Course
PHT 202	Pharmaceutics IV (Dosage forms and Formulations)	3	PHT 201	☼
PHT 203	Pharmaceutics V (Biopharmaceutics A)	3	PHT 201	☼
MBL 251	Pharmaceutical Microbiology I (General)	3	.....	☼
IML 261	Immunology (Fundamentals of Immunology)	3	.....	.....
PHC 272	Pharmaceutical Chemistry V (General Chemical Reaction)	3	PHC 172	☼
PHG 282	Pharmacognosy III (Natural Products Chemistry)	3	PHG 281	☼
LAB-8	Pharmaceutical Laboratory 8	1	.....	.....
LAB-9	Pharmaceutical Laboratory 9	1	.....	.....
LAB-10	Pharmaceutical Laboratory 10	1	.....	.....
SEM-3	Pharmaceutical Seminar-3	1	.....	.....
TOTAL		22		

PHT 202 (Credit hours 3)

**Pharmaceutics IV
(Dosages Forms and Formulation B)
B. Pharm., Second Year, Fourth Semester**

Course Objectives:

The students will become familiar with the commonly administered dosage forms, their characteristics and preparations methods, which shall provide a broad view of pharmaceuticals.

Unit	Course Description	Hours	Details	Suggestions
1.	Dermatological Dosage Forms	15		
	Percutaneous absorption, Skin, Transdermal drug delivery systems, Ointments, Preservation, Creams, Pastes, Lotions, Topical solutions, Tinctures, Liniments, Collodions, Glycerogelations, Plasters, Powders for application to the skin, Topical aerosols, Tapes, Packaging		Structure and Physiology of Skin, percutaneous absorption of drugs Factors affecting transdermal bioavailability (Physiological and Formulation), Advantages and Disadvantages of Transdermal Drug Delivery, Current Technology for Transdermal Drug Delivery, New and Evolving Technologies for Transdermal Drug Delivery (chemical penetration enhancer, Iontophoresis, Prodrug, Novel Formulation approaches). Ointments, paste, gel and other semisolid dosage forms: definition and classification of semisolid classification of ointment bases, selection of ointment base, formulation and manufacturing of ointment paste and gel, rheological consideration, evaluation and quality analysis. Classification, Formulation, Manufacturing, properties, advantages. Disadvantages, packaging, evaluation and quality analysis of Lotions, Topical solutions, Tinctures,	

			Liniments, Collodions, Glycerogelations, Plasters, Powders for application to the skin, Topical aerosols, Tapes, Packaging	
2.	Dosage Forms Applied Topically to Eye, Ear, Nose and Oral Cavity	8		
	Ophthalmic preparations, Sterilization and preservation, Isotonicity, Ophthalmic solutions, Ophthalmic suspensions, Ophthalmic ointments, Ophthalmic inserts, Contact lenses, Nasal preparations, Optic preparations, Packaging		Ophthalmic preparations, Requirements, Sterilization and preservation, Isotonicity, Ophthalmic solutions, Ophthalmic suspensions, Ophthalmic ointments, Ophthalmic inserts, Contact lenses, Nasal preparations, Optic preparations, formulation, preservatives and choice thereof, methods of preparation, containers and evaluation.	
3.	Rectal, Vaginal and Urethral Dosage Forms	6		
	Suppositories, Vaginal dosage forms, Urethral preparations, Packaging		Suppositories, Vaginal dosage forms and Urethral preparations: Ideal requirements, advantages & disadvantages, classification, bases, formulation, manufacturing procedure, displacement value of testing of suppositories, mechanism of absorption of medicaments from the dosage forms, packaging and evaluation.	
4.	Pharmaceutical Aerosols	6		
	Aerosols, Containers, Inhalations, Sprays		Pharmaceutical Aerosols: Definition, propellants, general formulation, different types of atomizers, manufacturing and packaging methods, pharmaceutical applications.	

			Containers, Inhalations, Sprays.	
5.	Radiopharmaceuticals	3		
	The practice of nuclear pharmacy, Positron emission tomography, Radiopharmaceuticals		Introduction to radioactive elements, types of elements that possess radioactive properties, Positron emission tomography, their uses in pharmaceutical and medical sciences.	<i>This is the chapter which is covered in the section of Pharmaceutical Chemistry (Inorganic Pharmacy). So, it is better to replace this chapter by the chapter named “Blood Products and Plasma Substitutes”*</i>
6.	Biotechnology and Drugs	4		
	Recombinant DNA, Products of biotechnology, The future, Role of pharmacist		Pharmacist and Biotechnology, Approved biotechnological product and vaccines, GMP compliance and biopharmaceutical facilities..Recombinant DNA Technology: Introduction, Cutting and rejoining of DNA, Mutagenesis, Polymerase Chain Reaction (PCR) in gene amplification, Pharmaceutical application of recombinant DNA technology, Drug delivery system, Gene therapy, Basic Molecular mechanism of gene transfer, Prerequisite of human gene therapy, gene therapy for cancer and HIV, Various problems in gene therapy.	
7.	Novel Drug Delivery Systems	3		

	Drugs and vaccines presently available on the market, The future		Advanced Drug Delivery and Targeting, An overview of Implantable System, Drug Targeting Systems: Fundamentals and Applications to Parenteral Drug Delivery, Oral Transmucosal Drug Delivery, Nasal Drug Delivery and Pulmonary Drug Delivery.	
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Reference Books:

1. Howard C. Ansel, Loyd V. Allen and Nicholas G. Popovich: *Pharmaceutical Dosage form and Drug Delivery System* (7th Ed.) 1999, Lippincott Williams and Wilkins, Philadelphia.
2. Michael E. Aulton (Ed.): *Pharmaceutics, The Science of Dosage Form Design*, 1999, Churchill Livingstone, International Student Edition, New Delhi.
3. E. A. Rowlinson (Ed.): *Bentley's The Textbook of Pharmaceutics* (8th Ed.) 2001, Bailliere Tindall, London.
4. A. R. Gennaro (Ed.): *Remington's Pharmaceutical Sciences* (18th Ed.) 1990, Mack Publishing Company, Easton.

* **Blood Products and Plasma Substitutes:** Collection, processing and storage of; whole human blood, concentrated human RBC, dried human plasma, human fibrinogen, human thrombin, human normal immunoglobulin, human fibrin foam, plasma substitutes, ideal requirements, PVP, dextrin, etc., control and/or maintenance of blood pressure.

PHT 203 (Credit hours 3)

**Pharmaceutics V
(Biopharmaceutics A)**

B. Pharm., Second Year, Fourth Semester

Course Objectives:

This course will provide the students the knowledge on general principles of bioavailability and biopharmaceutics applicable to pharmaceutical sciences.

Unit	Course Description	Hours	Details
1.	The Concept of Biopharmaceutics	10	
	General principles of drug absorption, Dissolution and drug absorption, Biological membranes and drug transport, Routes of administration and absorption processes		<p>Introduction To Biopharmaceutics And Pharmacokinetics</p> <p>Drug Product Considerations</p> <ul style="list-style-type: none"> ➤ Pharmacokinetics of the Drug ➤ Bioavailability of the Drug ➤ Dose Considerations ➤ Dosing Frequency ➤ Patient Considerations ➤ Route of Drug Administration <p>Absorption of Drug</p> <p>Gastrointestinal Absorption of Drugs</p> <p>Cell Membrane Structure and Physiology</p> <p>Mechanism of Drug Absorption</p> <ul style="list-style-type: none"> ➤ Passive diffusion ➤ Pore transport ➤ Facilitates diffusion ➤ Active transport ➤ Ionic or electrochemical diffusion ➤ Ion pair transport ➤ Endocytosis <p>Factors influencing GI absorption of drug from its dosage form</p> <p><u>I. Pharmaceutics factors:</u></p> <ul style="list-style-type: none"> ➤ Physiochemical properties of Drug substances..... ➤ Dosage form Characteristics and Pharmaceutical Ingredients <p><u>II. Patient related factors</u></p> <p>(Anatomy and physiology consideration of GI tract, GI content and interaction)</p> <p>Route of Administration</p>

			(Buccal/ sublingual, rectal route, topical route Intramuscular Administration, Subcutaneous Administration, Inhalation Drug Delivery, Nasal Drug Delivery, Intraocular Administration, Vaginal Administration.....)
2.	Pharmacokinetic Principles	8	
	Reaction rate and Reaction order, Half-life, Concept of clearance, Dosage regimen considerations, Blood concentration-time curve		<p>PHARMACOKINETIC PRINCIPLES</p> <p>Plasma drug concentration time curve with detail labeling</p> <ul style="list-style-type: none"> ➤ Pharmacokinetic parameters ➤ Pharmacodynamic parameters <p>Rate, Rate Constants and Orders of Reactions</p> <ul style="list-style-type: none"> ➤ Zero order Kinetics (Constant Rate Processes) ➤ First Order Kinetics (Linear Kinetics) ➤ Mixed Order Kinetics <p>Half life (Calculation of half life first and zero order kinetics)</p> <p>Concept of Clearance</p> <p>Dosage Regimen Consideration</p> <ul style="list-style-type: none"> ➤ Individualization of Drug Dosage Regimens ➤ Drug Selection ➤ Dosage Regimen Design ➤ Determination of Dose ➤ Determination of Frequency of Drug Administration ➤ Loading Dose ➤ Determination of Route of Administration ➤ Dosing of Drugs in Infants and Children ➤ Dosing of Drugs in the Elderly
3.	Fate of Drugs after Administration	8	
	ADME process, Pharmacokinetic models, Non-linear pharmacokinetics, Excretion of drugs		<p>Absorption Distribution of Drugs</p> <p>Tissue Permeation of the Drugs</p> <p>Physiochemical Properties of the Drug</p> <p>Physiological Barrier to Distribution of Drug (Simple capillary endothelial barrier, Simple</p>

		<p>cell membrane barrier ,Blood brain barrier, Cerebrospinal fluid barrier, Placental barrier ,Blood-testis barrier.....)</p> <p>Miscellaneous Factors Affecting Drug Distribution (Age, Pregnancy, obesity, Diet, Disease, Distribution volume,....)</p> <p>Metabolism</p> <p>Enzyme Kinetics</p> <p>Drug Biotransformation Reactions</p> <p>Pathways of Drug Biotransformation</p> <p>Hepatic Enzymes Involved in the Biotransformation of Drugs</p> <p>DRUG EXCRETION</p> <p>Renal Excretion of Drug (Glomerular Filtration, Active Tubular Secretion, Tubular Reabsorption.....)</p> <p>Factor Affecting Renal Excretion or Renal Clearance (Physiochemical properties of the drug, Plasma concentration of the drug, Distribution and binding characteristics of the drug, Urine PH, Blood flow to the kidney, Biological factors , Drug interaction , Disease states)</p> <p>Non Renal Routes of Drug Excretion</p> <ul style="list-style-type: none"> ➤ Biliary excretion ➤ Pulmonary excretion ➤ Salivary excretion ➤ Mammary excretion ➤ Skin/dermal excretion ➤ Gastrointestinal excretion ➤ Genital excretion <p>Concept of Clearance</p> <ul style="list-style-type: none"> ➤ Renal Clearance ➤ Measurement of Glomerular Filtration Rate ➤ Renal Function ➤ Dose Adjustment ➤ Extracorporeal Removal of Drugs
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			<ul style="list-style-type: none"> ➤ Dialysis ➤ Peritoneal Dialysis ➤ Hemodialysis ➤ Pharmacokinetic Models <p>Compartmental Modeling (Use of compartmental model)</p> <ul style="list-style-type: none"> ➤ One-Compartment <p>Drug Clearance in the One-Compartment Model</p> <ul style="list-style-type: none"> ➤ <i>Two compartment (intravascular and extravascular administration</i> ➤ Multi Compartment (<i>Mammillary model, Caternary model</i>) <p>Non-compartmental modeling</p> <p>Physiological modeling</p> <p>Non Linear Pharmacokinetics</p> <ul style="list-style-type: none"> ➤ Cause of Nonlinearity ➤ Clinical and Adverse Toxicity Due to Nonlinear Pharmacokinetics ➤ Bioavailability of Drugs that Follow Nonlinear Pharmacokinetics
4.	Bioavailability and Bioequivalence	13	
	The concept of bioavailability, Factors affecting bioavailability, Drug absorption from GI tract, Assessment of bioavailability, <i>In vitro</i> and <i>in vivo</i> bioavailability testing, Regulatory bioavailability requirements		
5.	Drug Interactions and Incompatibilities	6	
	pH effect <i>in vitro</i> and <i>in vivo</i> , Cation-anion interaction, Chelation and complexation, Adsorption of drugs, Drugs interactions with plastics, Protein binding, Drugs interaction based on physical		<p>Bioavailability</p> <p>Objective of bioavailability studies</p> <p>Relative Availability</p> <p>Absolute Availability</p> <p>Factors Affecting Bioavailability (pharmaceutical related, patients related and route of administration</p>

	mechanism	<p>Assessment of Bioavailability</p> <ul style="list-style-type: none"> ➤ Pharmacokinetic methods (Plasma level time studies & Urinary excretion studies) ➤ Pharmacodynamic methods (Acute pharmacological response & Therapeutic response) <p>Method for enhancement of bioavailability</p> <p>In Vitro Drug Dissolution Factor that must be consider in the designing of a dissolution test Compendial methods of dissolution</p> <p>In-Vivo Bioequivalence Studies (Biowaivers)</p> <p>In-Vitro–In-Vivo Correlation</p> <p>BIOEQUIVALENCE STUDIES</p> <p>Definition and Other Terms Related to Bioequivalence (<i>Equivalence, Pharmaceutical equivalents, Bioequivalent drug products, Therapeutic equivalents, Drug product, Drug substance, Single source drug products, A multisource drug product, Generic name, Brand name, Generic substitution, Pharmaceutical alternatives, Pharmaceutical substitution, Therapeutic alternatives Therapeutic substitution,</i></p> <p>Bioequivalence –When Regulatory Requirements</p>
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Reference Books:

1. Howard C. Ansel, Loyd V. Allen, Jr., and Nicholas G. Popovich: *Pharmaceutical Dosage form and Drug Delivery System* (7th Ed.) 1999, Lippincott Williams and Wilkins, Philadelphia.
2. A. T. Florence and D. Attwood: *Physicochemical Principles of Pharmacy* (2nd Ed) 1994, The Macmillan Press Ltd., London.
3. Michael E. Aulton (Ed.): *Pharmaceutics, The Science of Dosage Form Design*, 1999, Churchill Livingstone, International Student Edition, New Delhi.
4. P. I. D. Lee and G. L. Amidon: *Pharmacokinetic Analysis: A Practical Approach*, 1996, Technomic Publ. Co, Lancaster.

MBL 251 (Credit hours 3)

**Pharmaceutical Microbiology I
(General)**

B. Pharm., Second Year, Fourth Semester

Course Objectives:

This course will provide the basic knowledge on microbiology and its general application to pharmaceutical preparation.

Unit	Course Description	Hrs	Details
1.	Fundamentals of Microbiology	10	
	Virus, Rickettsiae, Chlamydiae, Mycoplasma, Bacteria, Actinomycetes, Fungi,		Introduction & history of microbiology Virus: definition, structure, general lifecycle & classification; Rickettsiae: general properties, cultivation, infections; Chlamydiae: general properties, classification based on human infections; Mycoplasma: general properties, cultivation, infection; Actinomycetes: morphology, pathogenesis, clinical diseases; Fungi: general properties, morphological classification, classification based on reproduction, fungal infections; Bacteria: introduction, general requirements for bacterial growth, bacterial growth phase, anatomy of bacterial cell, gram positive & gram negative bacteria, classification based on shape & arrangement, bacterial culture media
2.	The Action of Physical and Chemical Agents on Micro-organisms	10	
	The kinetics of cell inactivation, Antimicrobial effect of moist and dry heat, Ionizing Radiation, Ultraviolet radiation, Gases, Antimicrobial effects of Chemical agents, Antibiotics and chemotherapeutic agents		Kinetics of cell inactivation: definition & derivation, condition influencing antimicrobial action; Dry heat sterilization: principle & types; Moist heat sterilization; procedure & types, autoclaving; Chemical sterilization: ethylene oxide, formaldehyde, formalin, hydrogen peroxide; Disinfectants: high level, intermediate & low level, alcohol, heavy metals & their compounds, phenolic compounds;

			<p>Radiations: ionizing & non ionizing, x-ray, gamma rays, electron beams, UV rays;</p> <p>Antibiotics & chemotherapeutic agents: Introduction & history, classification of antibiotics based on mode of action- cell wall inhibitors, protein synthesis inhibitors, metabolic inhibitors;</p> <p>Antifungal agents: Polyenes, azoles, nucleoside derivatives.</p>
3.	Principles of Sterilization	4	
	The importance of sterility, Definition, Determination of sterilization protocols, Integrated lethality in sterilization practice, Test for sterility of the products		<p>Sterility: definition, principle; Thermal death time & decimal reduction time, Z-value; Sterility test method- sterility standards of different pharmaceutical products, growth promotion test; Test methods-Method A(membrane filter method) & method B(direct method)</p>
4.	Microbial Contamination and Preservation of Pharmaceutical Preparation	6	
	Source and incidence of contamination, Growth of microorganisms in pharmaceutical products, Consequences of contamination, Screening for contamination, Control of microbial contamination, The preservation of pharmaceutical preparation, Microbial standard for pharmaceutical preparation		<p>Source & incidence of contamination- water, environment, packaging material, human source, equipments; Growth & consequences of microbial contamination- physical changes seen on the products, pharmaceutical ingredients susceptible to microbial attack; control of microbial attack- on various aspects as raw material& water, environment, human sources, equipments; Preservation of medicines- different preservatives used; screening of contamination- direct & membrane filter test; Microbial standard of pharmaceutical preparations- water, raw material, finished products.</p>
5.	Pharmaceutical Application of Microbiological Techniques	8	
	Measurement of antimicrobial activity, Antibiotic assay, Aminoacid and vitamin assay, The measurement of minimum inhibitory concentration (MIC), Counting of micro-organism in pharmaceutical products, Pyrogen testing, Challenge tests (preservative		<p>Measurement of antimicrobial activity- tube dilution technique, disc diffusion technique & phenol coefficient method; Antibiotic assay- cylinder plate method, perforated plate method, Turbid metric method; Amino acid & vitamin assay- concept & procedure;</p>

	efficacy test), Disinfectant evaluation		Challenge test- concept & procedure; Counting of microorganism- plate count method, multiple or serial dilution method & membrane filtration method.
6.	Biologicals	7	
	Production of vaccines and antisera, Biological testing and pathogenecity, Toxicity, Pyrogen tests		Production of vaccines- types of vaccines, production of microbial vaccines- various steps involved; production of antisera- concept & procedure; Biological testings- pyrogen test, Bacterial endotoxin test, Depressor substances test, biological reactivity test, systemic injection test, Intracutaneous test & implantation test; Pathogen city- portal of entry, penetration of host immune defences; Toxicity- definition, types, health hazards, classification.

Reference Books:

1. M. E. Aulton (Ed.): *Pharmaceutics, The Science of Dosage Form Design*, 1999, Churchill Livingstone, International Student Edition, New Delhi.
2. E. A. Rowlinson (Ed.): *Bentley's The Textbook of Pharmaceutics* (8th Ed.) 2001, Bailliere Tindall, London.
3. W. B. Hugo and A. D. Russel: *Pharmaceutical Microbiology* (6th Ed.) 1998, Blackwell Scientific Publication, Oxford.
4. M. J. Pelczar, E. C. S. Chan and N. R. Krieg: *Microbiology* (5th Ed.) 1986, Tata Mc Graw-Hill Book Company, New Delhi.

IML 261 (Credit hours 3)**Immunology
(Fundamentals of Immunology)**

B. Pharm., Second Year, Fourth Semester

Course Objectives:*This course will provide the fundamental knowledge on the immune system.*

Unit	Course Description	Hours	Details
1.	Introduction to the Immune System	6	
	Adaptive and innate immunity, Cells of the immune system, Soluble mediators of immunity, Antigens, Immune responses, Defences against extracellular and intracellular pathogens, Vaccination, Immunopathology		Immunity, types of immunity, cells involved, mediators of immunity, soluble mediators, (Ags, Complement), Ags and their types for immune responses (Clonal selection), Defences against extracellular and intracellular pathogens, defenses for pathogens by vaccination (principle, types) immunopathology (Types with definition, inflammation, Hypersensitivity,).
2.	Cells Involved in Immune Responses	4	
	Lymphoid cells, Mononuclear phagocyte system, Polymorphonuclear granulocytes and platelets		Morphology, different types (neutrophil, eosinophil, basophils and mast cells), functions in immune response. Cell markers
3.	The Lymphoid System	4	
	Primary and secondary lymphoid tissue, Primary lymphoid organs, Secondary lymphoid organs and tissues, Lymphocyte traffic		Role and function of different lymphoid tissue and organs (Primary lymphoid organs, Secondary lymphoid tissues) lymphocyte traffic.
4.	Antigen Receptor Molecules	4	
	Immunoglobulins, T-cell antigen receptors, Major histocompatibility complex antigens		Structure and function of different immunoglobulins, mechanism of T cell Ag receptor structure and function of different classes of MHC.
5.	Antigen Recognition	6	
	Antigen-Antibody binding, The structure of antigens, T-cell-antigen recognition, Antigen processing and presentation, Role of accessory molecules, basic immunological application (Immunofluorescence, RIA, ELISA)		Mechanism of Ag-Ab binding, Immunological application- different types, procedure and application. Antigen-Antibody binding, The structure of antigens, T-cell-antigen recognition, Antigen processing and presentation, Role of accessory molecules, basic immunological application (Immunofluorescence, RIA, ELISA)

6.	Cell Cooperation in the Antibody Response	4	
	Cooperation between different cell types, Cell activation, Antibody responses <i>in vivo</i>		Antigen presenting, antigen processing, T cell dependent and independent antigens, Haptens and carriers, Cell activation,(Role of interleukins, costimulatory signals), Activation in response to Ags and its response <i>in vivo</i> .(Enhanced secondary response, Class switching, Affinity maturation)
7.	Cell-Mediated Immune Reactions	6	
	T-cell-independent cell-mediated defense mechanism, T-cell-dependent cell-mediated responses, Cell-mediated cytotoxicity, Lymphokine-mediated activation of macrophages, Granuloma formation, Immunopathology, The cytokine network		T-cell-independent cell-mediated defense mechanism, (Phagocytosis, attachment, uptake , cytokine release) T-cell-dependent cell-mediated responses, regulatory role of cytokines, Antibody dependent and antibody independent cell mediated cytotoxicity, Cell-mediated cytotoxicity, Lymphokine-mediated activation of macrophages, Granuloma formation, Immunopathology, The cytokine network
8.	Regulation of the Immune Response	4	
	Regulation by antigen, Regulation by antibody, Regulation by immune complexes, Regulation by lymphocyte		Regulation by antigen, Regulation by antibody, Regulation by immune complexes, Regulation by lymphocyte
9.	Immunological Tolerance		
	T-cell tolerance to self antigens, B-cell tolerance to self antigens, Artificially induced tolerance <i>in vivo</i> , Artificially induced tolerance <i>in vitro</i> , Potential therapeutic applications of tolerance.	4	T-cell tolerance to self antigens, B-cell tolerance to self antigens, Artificially induced tolerance <i>in vivo</i> , Artificially induced tolerance <i>in vitro</i> , Potential therapeutic applications of tolerance.
10.	Complement	4	
	Introduction, Activation of complement, Complement receptors, Biological effects of complement		History, nomenclature, activation of complement system, different complement pathway, Membrane attack complex, Biological effects of complements-complement, inflammation and anaphylatoxins.

Reference Books:

1. Ivan Roitt, Jonathan Brostoff and David Male (Ed.): *Immunology* (3rd Ed.) 1993, Mosby-Year Book Europe Limited, London.
2. Ivan Roitt: *Essential Immunology* (8th Ed.) 1994, Blackwell Scientific Publication, London.

Suggested books:

Thomas J. Kindt, Richard A. Goldsby and Barbara A. Osborne (6th Ed.) *Immunology* 2007, W. H. Freeman and Company, New York.

PHC 272 (Credit hours 3)**Pharmaceutical Chemistry
(Basic Organic Reaction)**

B. Pharm., Second Year, Fourth Semester

Course Objectives:

This course is designed to understand the basic principles of reaction mechanism of some common organic reactions.

Unit	Course Description	Hours	Details
1.	Nucleophilic Aliphatic Substitution	10	
	Definition of nucleophilic aliphatic substitution reaction, Nucleophile and leaving groups, Mechanism and kinetics of SN2 reaction, Role of substrate, Stereochemistry, Steric hindrance and solvent in SN2 reaction, Mechanism and kinetics of SN1 reaction, Role of substrate, Stereochemistry, Steric hindrance and solvent in SN1 reaction, Comparative study of SN1 and SN2 reactions, Some biologically important substitution reactions.		John McMurry, <i>Organic Chemistry</i> 5th Ed
2.	Electrophilic Aromatic Substitution	8	
	Introduction, Effect of substituent groups, Determination of orientation, Determination of relative reactivity, Classification of substituent group, Orientation of disubstituted benzene, Mechanism of nitration and sulfonation.		John McMurry, <i>Organic Chemistry</i>
3.	Nucleophilic Acyl Substitution Reaction	8	
	Introduction to carboxylic acid derivatives and nitriles, Nucleophilic acyl substitution reactions, Nucleophilic acyl substitution reactions of carboxylic acid, Chemistry of acid halides, acid anhydrides, esters, amides, nitriles, thiol ester, Biological carboxylic acid derivatives		John McMurry, <i>Organic Chemistry</i>
4.	Elimination Reaction	8	
	Definition and types of elimination reaction, Zaitsev's rule, Kinetics and mechanism E2 reaction, Elimination reaction and cyclohexane conformation, Kinetics and mechanism E1 reaction, Comparative study of E2 and E1, Elimination vs. substitution, Dehydration of alcohol		John McMurry, <i>Organic Chemistry</i>
5.	Addition Reaction	5	
	Addition of halogen to alkene, Halohydrin formation, Addition of water to alkenes		John McMurry, <i>Organic Chemistry</i>

	(oxumercuration, hydroboration), Addition of carbene to alkene, Hydrogenation		
6.	Nucleophilic Addition Reaction	6	
	Aldehydes and ketones, Nucleophilic addition reaction of aldehydes and ketones, Relative reactivity of aldehyde and ketone, Nucleophilic addition of water, HCN, Grignard reagent, amines, hydrazine, alcohols, phosphorus ylide		John McMurry, <i>Organic Chemistry</i>

Reference Books:

1. John McMurry, *Organic Chemistry* (5th Ed.) 2000, Brooks/Cole Publishing Company (Asian Books Pvt. Ltd.), Pacific Grove.
2. Robert Thornton Morrison and Robert Neilson Boyd, *Organic Chemistry* (6th Ed.) 1999, Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Jerry March, *Advanced Organic Chemistry* (4th Ed.) 2000, John Wiley and Sons, New York.
4. Ernest L. Eliel, *Stereochemistry of Carbon Compounds*, 1998, Tata-McGraw-Hill Pub. Co. Ltd, New Delhi.

PHG 282 (Credit hours 3)**Pharmacognosy III
(Natural Products Chemistry)**

B. Pharm., Second Year, Fourth Semester

Course Objectives:

This course is designed to understand general principles of chromatographic methods used for the separation and isolation of organic compounds obtained from natural and synthetic sources.

Unit	Course Description	Hours
1.	Drugs and Natural products	3
	An outline on discovery of some important drugs from natural products, History of natural products chemistry, Bioactivity screening of organic natural products	
2.	Extraction, Isolation and Purification	8
	General techniques of extraction, separation, and purification. Column chromatography, Thin-layer chromatography (TLC), Paper chromatography, Ion-exchange chromatography, Gas chromatography, Gel Chromatography, Droplet counter current chromatography, High performance liquid chromatography (HPLC), Electrophoresis, High performance capillary electrophoresis (HPCE)	
3.	Structure Determination	5
	Use of spectroscopic technique to elucidate the structure of natural products	
4.	Biosynthesis	4
	An outline of biosynthesis of natural products: Sugar, Isoprenoids, Polyketides, Phenylpropanoids, Amino acids, Polypeptides, Alkaloids, Concept of chemotaxonomy	
5.	Fatty acids and Related Compounds	5
	Aracidonic acid cascades, Prostaglandins, Thromboxan and prostacyclin, Leukotriene and hydroperoxyeicosatetrenoic acid, eicosapentanoic acid	
6.	Terpenoids	7
	Introduction, Classification, General method of determining structure, Monotepenes, Sesquiterpene, Diterpenes, Sestertepene, Triterpenes	
7.	Carotenoids	5
	Introduction, Carotenes, β -Carotenes, α -Carotenes, Lycopenes, γ -Carotenes, Vitamin A, Xanthophyllus, Biosynthesis of carotenoids	
8.	Steroids	
	Introduction, Sterols, Cholesterol, Spectral properties of steroids, Stereochemistry of steroids, Ergosterol, Vitamin D, Stigmasterol, Biosynthesis of sterol, Bile acids, Steroid hormones, Homosteroids and Norsteroids, Adrenocortical hormones, Steroidal glycosides and alkaloids	

Reference Books:

1. Mitsubashi et al (Ed) *Integrated Essential Natural Product Chemistry* (3rd Ed.) 1999, Minami Publishing House, Tokyo (Japanese).

2. I. L. Finar: *Organic Chemistry Volume 2: Stereochemistry and Chemistry of Natural Products* (5th Ed.) 2000, Longman Scientific and Technical (Pearson Education Asia), New Delhi.
3. Gurdeep R. Chatwal: *The Chemistry of Organic Natural Products* Vol I and II, 1983, Himalaya Publishing House, Bombay.
4. Paul M. Dewick: *Medicinal Natural Products, A Biosynthetic Approach* (2nd Ed.) 2002, J. Wiley and Sons, Chichester.

LAB-8 (Credit hour 1)

Pharmaceutical Laboratory-8

B. Pharm., Second Year, Fourth Semester

Course Objectives: *The students will become familiar with the basic principles of manufacturing of drug dosage forms and formulations (B)*

Course Contents:

1. Ointments and creams
2. Pastes and lotions
3. Accelerated stability testing
4. Ophthalmic preparations
5. Nasal preparations
6. Otic preparations
7. Suppositories and vagitories

LAB-9 (Credit hour 1)

Pharmaceutical Laboratory-9

B. Pharm., Second Year, Fourth Semester

Course Objectives: *Student will learn simple preparation and Pharmacopoeal standards of some pharmaceutical products.*

Course Contents:

1. Preparation of some pharmaceutical compounds as mentioned in Japanese Pharmacopoeia and Indian Pharmacopoeia (at least five samples)
2. Assay of Pharmaceutical compounds as mentioned in relevant Pharmacopoeia (at least 5 sample)

Reference Books:

1. Japanese Pharmacopoeia XIII
2. Indian Pharmacopoeia (1996)

LAB-10 (Credit hour 1)

Pharmaceutical Laboratory-10

B. Pharm., Second Year, Fourth Semester

Course Objectives: *Student will take part in field trip and prepare 20 herbaria and collect 10 crude drugs from the field.*

Course Contents:

1. Preparation of herbarium (at least 20 sample each) and crude drug (at least 10 sample each) in the field and identify and preserve in the laboratory. Prepare one report on collection and identification.

Third Year

Fifth Semester

FIFTH SEMESTER

Code	Description	Credit hours	Pre-requisite course	Core Course
PHT 301	Pharmaceutics VI (Biopharmaceutics B)	3	PHT 203	☼
PHT 302	Pharmaceutics VII (Pharmaceutical Engineering and Drawing)	3	.....	☼
PHL 311	Pharmacology I (Therapeutics)	3	.....	☼
APL 331	Anatomy and Physiology (Pathophysiology)	3	APL 231	☼
PHC 371	Pharmaceutical Chemistry VI (Name Reaction)	3	PHC 172	☼
PHG 381	Pharmacognosy IV (Natural Products Chemistry)	3	PHG 281	☼
LAB-11	Pharmaceutical Laboratory 11	1	.....	.....
LAB-12	Pharmaceutical Laboratory 12	1	.....	.....
LAB-13	Pharmaceutical Laboratory 13	1	.....	.....
SEM-4	Pharmaceutical Seminar-4	1	.....	.....
TOTAL		22		

PHT 301 (Credit hours 3)

Pharmaceutics VI
(Biopharmaceutics B)
B. Pharm., Third Year, Fifth Semester

Course Objectives:

This course will provide the students with the further knowledge on bioavailability and bioequivalence of pharmaceutical products, with special emphasis on pharmacokinetics and pharmacodynamics and factors affecting the both.

Unit	Course Description	Hrs.	Details
1	Influence of Formulation on Pharmacokinetics - Bioequivalence Pharmacokinetic models, Requirements	4	Definition bioequivalence When necessary and when not necessary bioequivalence study Pharmacokinetic and pharmacokinetic models Compartmental modeling <i>model I monoexponential terminal phase</i> <i>model II biexponential terminal phase</i> Case study case 1 large intrasubject variability in elimination case 2 large variation in elimination and distribution with two respective examples
2	Influence of Dosage on Pharmacokinetics - Dose Proportionality Pharmacokinetic models, Concentration profiles of drugs and metabolites	4	<i>Proportionality and Linearity</i> <i>Factors cause dose nonlinearity</i> Models used to describe pharmacokinetic parameters <i>Model I: Drugs without Information about Metabolism</i> <i>Model II Drugs with the Concentration Profiles of Metabolites</i> Case study <i>Case I: Saturable Absorption and Renal Excretion</i> <i>Case 2: Saturable Metabolism</i> <i>Two examples for case respective case</i>
3	Pharmacokinetics of Sustained Release and Immediate Release Formulations	5	The objective of designing sustained release

	<p>Formulations with first-order release rate, Zero-order release, Immediate-release plus zero-order release</p>		<p>Some common themes in the sustained release versus immediate release</p> <p>Three models are used to explain pkt parameters</p> <p><i>The first model describes formulations with a first-order release rate;</i></p> <p><i>The second model describes formulations with a zero-order release rate; and</i></p> <p><i>The third model describes formulations with a combined immediate release and zero-order release rate</i></p> <p>Case studies</p> <p><i>Case 1: First-Order Release</i></p> <p><i>CASE 2: Zero-order Release</i></p> <p><i>Case 3: Immediate Release Plus Zero-Order Release</i></p> <p>and Three examples</p>
4	<p>Absorption of Drugs in the Gastrointestinal Tract</p> <p>Influence of gastric emptying, Constant intrainestinal infusions, Effect of various GI sites</p>	4	<p><i>Use of gastrointestinal intubation study (infusion and perfusion study)</i></p> <p><i>In this section three pharmacokinetic models used</i></p> <p><i>The first model describes the effect of gastric emptying on the plasma concentration profile;</i></p> <p><i>The second model describes constant intrainestinal infusions; and</i></p> <p><i>The third model describes the first pass effects</i></p> <p>Case Studies</p> <p><i>Case 1: Difference in Absorption at Various Gastrointestinal Sites</i></p> <p><i>Case 2: Identify Differences in Absorption Rate at Various Intestinal Sites by Intrainestinal Infusion</i></p> <p><i>Case 3: Different Degrees of Presystemic Metabolism at Various Intestinal</i></p> <p><i>And three examples for respective</i></p>

			<i>case</i>
5	<p>Drug Distribution into Tissue – Tissue Penetration Irreversible distribution, Reversible distribution, Penetration into sputum, Penetration into saliva, Penetration into blister fluid</p>	4	<p>Tissue penetration study (reversible and irreversible) Factor affecting tissue penetration Four models are discussed for pharmacokinetic parameter estimation <i>The first model describes an irreversible distribution;</i> <i>The second model describes a reversible distribution;</i> <i>The third model is an isolated multi-compartment model with an irreversible distribution;</i> <i>The fourth model is an isolated multicompartment model with a reversible distribution</i> Case Studies <i>CASE 1: Irreversible Tissue Penetration</i> <i>Case 2: Reversible Tissue Distribution</i> <i>Case 3: Isolated Multi-Compartmental Model</i> <i>At least three examples</i></p>
6	<p>Pharmacokinetics of Metabolites Parallel metabolic pathways, Metabolic pathways in series, Reversible metabolism with elimination from the parent drug, Reversible metabolism with elimination from the metabolite, Reversible metabolism with elimination from both parent drug and metabolite, Combination of irreversible and reversible metabolic pathways</p>	6	<p>Metabolites and objective of metabolites Six models are used to discuss metabolites <i>model 1: parallel metabolic pathway</i> <i>model 2: metabolic pathway in series</i> <i>model 3: reversible metabolism with elimination from the parent drug</i> <i>model 4: reversible metabolism with elimination from the metabolite</i> <i>model 5: reversible metabolism with elimination from both parent drug and metabolite</i> <i>model 6: combination of irreversible and reversible metabolic pathways</i></p>

			<p>Case studies <i>case 1: parallel metabolic pathways</i> <i>case 2: metabolic reactions in series</i> <i>case 3: reversible metabolic reactions</i> <i>case 4: polymorphism</i> <u><i>And 5 or 6 examples</i></u></p>
7	<p>Relationship between Pharmacokinetics and Pharmacodynamics 6 hours Irreversible relationship between central and effect compartments, Reversible relationship between central and effect compartments, Two-compartment pharmacokinetics with an irreversible relationship between pharmacokinetics and pharmacodynamics, Sequential responses, Isolated multi-compartment model with an irreversible relationship between the central and effect compartments, Isolated multi-compartment model with a reversible relationship between the central and effect compartments</p>	6	<p><i>The concentration/effect correlation</i> Six models are discussed that are useful in describing the pharmacokinetics, and pharmacodynamics relationships. <i>The first model describes an irreversible relationship between central and effect compartments; The second model describes a reversible relationship between the central and effect compartments; The third model describes a two-compartment pharmacokinetics with an irreversible relationship between pharmacokinetics and pharmacodynamics; The fourth model describes a sequence of responses evoked by a drug; The fifth model describes an isolated multi-compartment model with an irreversible relationship between the central and effect compartments; and The sixth model describes an isolated multi-compartment model with a reversible relationship between the central and effect compartments</i> Case study <i>Case 1: Irreversible Relationship between Plasma \ and Effect Concentration</i> <i>Case 2: Reversible Relationship between Plasma and Effect</i></p>

			<p><i>Concentrations</i></p> <p><i>Case 3: Two-Compartment Pharmacokinetic Model</i></p> <p><i>Case 4: Cascade of Pharmacological Effect</i></p> <p><i>Case 5: Isolated multi-compartment pk/pd model and 4 or 5 example</i></p>
8	<p>Influence of Food on Pharmacokinetic</p> <p>Effects of food on gastric emptying, Effects of food on drug solubility, Effects of food on first pass metabolism</p>	4	<p><i>The effects of food on oral drug absorption</i></p> <p><i>Drug-food interactions</i></p> <p><i>Four models that are useful in describing the food effects on pharmacokinetics</i></p> <p><i>The first model describes effects of food on gastric emptying;</i></p> <p><i>The second model describes effects of food on drug solubility;</i></p> <p><i>The third model describes effects of food on the first pass metabolism; and</i></p> <p><i>The fourth model describes effects of food on both first pass metabolism and drug solubility.</i></p> <p><i>Case studies</i></p> <p><i>Case 1: food delays gastric emptying</i></p> <p><i>Case 2: food improves solubility</i></p> <p><i>Case 3: food reduces first pass metabolism</i></p> <p><i>Case 4: food improves solubility and reduces first pass effect</i></p> <p><i>And respective 4 examples</i></p>
9	<p>Influence of Age and Gender on Pharmacokinetics</p> <p>Effects of age on absorption and elimination, Effects of age on distribution, Effects of age on metabolism, Difference in distribution and metabolism, Difference in volume of distribution and metabolism, Pregnancy</p>	4	<p>Effect of age in absorption</p> <p>Three models those are useful in describing the effects of age on pharmacokinetics</p> <p><i>The first model describes effects of age on absorption and elimination;</i></p> <p><i>The second model describes effects of age on absorption, elimination, and distribution</i></p> <p><i>The third model describes effects of age on absorption, distribution, and metabolism</i></p>

			<p>Case study <i>Case 1: Renal Excretion and Volume of Distribution Change with Age</i> <i>Case 2: Protein Binding Changes with Age</i> <i>And two examples</i></p> <p>Difference in Pharmacokinetics between Genders The key pharmacokinetic parameters in a male versus female study <i>Model 1: Difference in the Distribution and Metabolism between Genders</i> <i>Case 1: Difference in Volume of Distribution and Metabolism between Genders</i> <i>Example for case study</i></p>
10	<p>Special Pharmacokinetic Considerations In renal impairments, In hepatic impairments, In other diseases</p>	4	<p>The effects of liver diseases on pharmacokinetics Two models those are useful in describing the pharmacokinetics in hepatic-impaired patients <i>Drugs with low first pass elimination and</i> <i>Drugs with high first pass elimination.</i> <i>Two case and examples</i></p>

Reference Books:

1. Peter I. D. Lee and Gordon L. Amidon: *Pharmacokinetic Analysis, A Practical Approach*, 1996, Technomic Publishing Co. Inc, Lancaster.
2. Alfonso R. Gennaro: *Remington: the Science and Practice of Pharmacy*, Volume II (20th Ed.) 2002, Lippincott Williams & Wilkins, Philadelphia.
3. Leon Shargel, Alan H. Mutnick, Paul F. Souney and Larry N. Swanson: *Comprehensive Pharmacy Review* (5th Ed.) 2004, Lippincott Williams & Wilkins, Philadelphia.

PHT 302 (Credit hours 3)

Pharmaceutics VII
(Pharmaceutical Engineering and Drawing)
B. Pharm., Third Year, Fifth Semester

Course Objectives:

This course will provide the students the necessary knowledge on basic pharmaceutical processes, machines applied in those processes and drawing techniques used in pharmaceutical engineering.

Unit	Course Description	Hrs.	Details
1	Extraction Processes Principles, Leaching processes, Percolation, Factors affecting the efficacy of the leaching processes, Liquid-liquid extraction	4	i) Defining Extraction, Extractives, Pharmaceutical products from extractions (Tinctures, Fluid extracts, Extracts) along with expression, infusions, decoctions (1 hr) ii) Briefly explaining percolation and maceration (2 hr) iii) Choice among percolation and extraction iv) Factors affecting the efficacy of leaching processes v) Liquid-liquid extraction (1 hr)
2	Heat Transfer and Drying Principles, Heat flow processes, Conduction, Convection, Radiation, Equipment, Tray dryer, Tunnel dryer, Rotary dryer, Infrared heating, Fluidized bed dryer, Drum dryer, Spray dryer, Freeze-dryer, Factors affecting drying processes	6	i) Defining heat and units of heat, listing pharmaceutical processes involve in heat transfer (1 hr) ii) Methods of heat transfer and mathematical equation and calculation of conduction – not in syllabus iii) Heating medium- steam (advantages, disadvantages) (1 hr) iv) Drying and theory of drying (0.5 hr) v) Equipments of drying Drying of damp solids (Tray, Tunnel, Rotary, Infrared heating, FBD (1.5 hr) Drying of slurries or solution (Drum and Spray) (1 hr) Specialized drying methods- Freeze drying

			Factors affecting drying processes (0.5 hr)
3	Evaporation Principles, Factors affecting the evaporation process, Small scale methods, Large scale methods, Steam traps	4	i) Defining evaporation and boiling ii) Heat transfer to boiling liquids in an evaporation (1hr) iii) Factors affecting evaporation processes (0.5 hr) iv) Evaporators – different types (2 hr) v) Steam Traps (0.5 hr)
4	Distillation Principles, Simple distillation under atmospheric pressure (small and large scale), Simple distillation under reduced pressure (small and large scale), Fractional distillation methods (small scale and boiling points diagrams), Distillation in steam (small scale and large scale)	4	i) Distillation and terms used in distillation with uses ii) Types of distillation (1 hr) iii) Simple distillation under atmospheric pressure iv) Simple distillation under reduced pressure v) Steam distillation : small and large scale vi) Fractional distillation with theoretical considerations (3 hr)
5	Centrifugation Principles, Small-scale and industrial-scale centrifuges, Efficacy	3	i) Principles (1hr) Small scale- Horizontal Swinging Arm type ii) Industrial scale- Perforated and Non-Perorated (2 hr)
6	Filtration Mechanism of filtration, Factors affecting the filtration rate, Methods, Sintered glass filters, Seitz filters, Membrane filters, Filter press, Metafilter, Drum filter, Air filtration	6	i) Filtration and terms in filtration, factors affecting the filtration rate (1 hr) ii) Sintered Glass filter, Seitz filter (1.5 hr) , Membrane filter, Filter Press (1hr) , metafilter, Drum filter, (1.5 hr) Air filtration (1hr)
7	Comminution, Sizing and Handling of Powders Principles of size reduction, Comminution machinery, Sieving and sifting, Efficacy and factors affecting size reduction, Determination of particle size, Handling properties of powders (sliding and flow), Screening and sieving, Mixing of powders, Granulation of powders, Transport, Dust control	9	i) Comminution, factors affecting size reduction ii) Machinery for size reduction iii) Mechanism and principles of size reduction (1.5 hr) iv) Comminution machinery (Mortar and pestle, Impact mill, ball mill, Pin Mill, Micronizers (5 hr) v) handling properties of powder vi) Mixing of powder vii) Granulation viii) Transport, Dust control

			ix) Sieving and equipment for sieving (1 hr) x) Determination of particle size (1.5 hr)
8	Flow of Fluids Principles, Fluid friction, Rheology and rheological properties measurements, Transportation of fluids, Mixing of liquid-liquid system, Homogenization, Pumps, Transportation of gases	4	i) Reynolds experiment and Number, Pharmaceutical rheology and importance (1 hr) ii) Rheological properties measurement- capillary viscometer (1 hr) iii) Transportation of fluids, Mixing of liquid- liquid system, Homogenization Pumps, Transportation of gases (2 hr)
9	Specific considerations Materials used in pharmaceutical manufacturing, Humidity control, Refrigeration, Sterile production, GMP and GLP	5	i) Materials used in Pharmaceutical manufacturing (1hr) ii) Humidity control, Refrigeration, Sterile production, GMP and GLP (4 hr)

Reference Books:

1. E. A. Rowlinson: *Bentley's Textbook of Pharmaceutics* (8th Ed.) 2001, Bailliere Tindall, London.
2. Leon Lachman, Herbert A. Lieberman and Joseph L. Kanig: *The Theory and Practice of Industrial Pharmacy* (3rd Ed.) 1987, Varghese Publishing House, Bombay.
3. (3rd Ed.) 1987, Varghese Publishing House, Bombay.
4. Sidney H. Willig: *Good Manufacturing Practices in Pharmaceuticals* (5th Ed.) 2001, Marcel Dekker, New York.

PHL 311 (Credit hours 3)

Pharmacology I (Therapeutics)

B. Pharm., Third Year, Fifth Semester

Course Objectives:

The students will become familiar with pharmacological principles of therapeutics, and pharmacology of drugs acting on specific systems/organs in the body (I).

Unit	Course Description	Hrs.	Details
1	General Principles Principles of therapeutics, Principles of toxicology, Pharmacodynamics	3	Principles of therapeutics: Explanation of terms commonly encountered in Pharmacology, Pharmacokinetics, Pharmacodynamics, Therapeutics Principles of toxicology: Adverse drug response (Definition, Types, Methods of Prevention), Drug toxicity (hypersensitivity reaction, Teratogenicity, carcinogenicity and Dependence) Pharmacodynamics: Principle of drug action, Dose response relationship, Therapeutic index, Receptor and its functions, Factors affecting drug response (Age, body weight, sex, pharmacogenetics, tolerance, Physical factors, Synergism, antagonism, cumulation)
2	Drugs Acting on Neuroeffector Junctional Sites Neurohumoral transmission and autonomic and somatic motor nervous system, Cholinergic agonists, Anticholinesterase agents, Atropine, Scopolamine and other antimuscarinic drugs, Agents acting at the neuromuscular junction and autonomic ganglia, Catecholamines and sympathomimetic drugs, Adrenergic receptor antagonists	10	Neurohumoral transmission and autonomic and somatic motor nervous system: Brief overview, Cholinergic receptors, adrenergic receptors, outline of actions Cholinergic agonists: Definition, classification, Mode of action, uses, adverse effects and contraindications of acetylcholine and Pilocarpine as prototypes. Anticholinesterase agents: Classification of anticholinesterase, Mode of action, uses and adverse effects of Neostigmine Anticholinergic Drugs: Definition, Classification Discussion- Atropine and Scopolamine as Prototype Explain the principles of treatment of myasthenia gravis, Organophosphorus poisoning

		<p>Agents acting at the neuromuscular junction and autonomic ganglia: Skeletal Muscle relaxants; Classification, Discussion of prototype drugs and commonly used ones. Briefly about Centrally acting Skeletal muscle relaxant List drugs acting on autonomic ganglia, Reasons for not preferring in therapy?</p> <p>Catecholamines and sympathomimetic drugs: Definition, classification (including clinical classification) Review of biosynthesis, storage and release Beta-adrenergic receptor agonists- selective and non selective (List drugs, pharmacological actions, uses and adverse effects) Alpha- adrenergic receptor agonists (List drugs, pharmacological actions, uses and adverse effects)</p> <p>Adrenergic receptor antagonists Alpha- blockers: Classification, Pharmacological action, uses and adverse effects, Prazosin (prototype) Beta- blockers: Classification, Pharmacological action, uses, adverse effects and contra indications, Propranolol (prototype) Advantages of cardioselective beta-blockers and their uses (Atenolol as prototype)</p>
3	<p>Drugs Acting on the CNS Neurohumoral transmission and CNS, Principles of anesthesiology, General anesthetics, Local anesthetics, Therapeutic gases, Hypnotics and sedatives, Drugs for treatment of psychiatric disorders, Antiepileptics, Antiparkinsonics, Opioid analgesics and Antagonist, Drug addiction and abuse</p>	<p>10</p> <p>Neurohumoral transmission and CNS: Definition, Briefly about the role of dopamine and acetylcholine in CNS</p> <p>Principles of anesthesiology: General anesthetics: Classification, Stages of anesthesia. Commonly used general anaesthetics with their actions, uses, adverse effects Dissociative anaesthesia, Preanaesthetic medication- rationale with examples</p> <p>Local anesthetics: Definition, Types (Techniques) of Local anaesthesia, Classification Mechanism of action, uses and adverse effects of imp local anesthetics- lignocaine, bupivacaine.</p>

		<p>Therapeutic gases: Definition, List and their uses</p> <p>Hypnotics and sedatives: Classification, Comparison of Barbiturate, Benzodiazepam and Newer non-benzodiazepines Mechanism of action, uses, side effects and contra indications of Benzodiazepam and Barbiturates Therapy of insomnia</p> <p>Drugs for treatment of psychiatric disorders: Classification, Mechanism of action, uses, Side effects and contraindication of Antipsychotics, Anti depressants and mood stabilizer</p> <p>Antiepileptics: Classification, types of epilepsy Mechanism of action, indications, adverse effects and contraindications of commonly used anti-epileptic drugs</p> <p>Antiparkinsonics: Classification Mechanism of action, indications, adverse effects and contraindications of commonly used anti-parkinsonics</p> <p>Opioid analgesics and Antagonist: Classification, Opioid receptors Mechanism of action, indications, adverse effects and contraindications of most commonly used drugs</p> <p>Drug addiction and abuse: Definition, Types and Management</p>
4	<p>Drug Therapy of Inflammation Introduction to autoacoids, Histamine, bradykinin, 5-hydroxytryptamine and their antagonists, Lipid-derived autoacoids, Antiasthmatic drugs, Analgesic-antipyretic and antiinflammatory agents, Drugs in treatment of rheumatoid arthritis and gout</p>	<p>10</p> <p>Introduction to autoacoids, Histamine, bradykinin, 5-hydroxytryptamine and their antagonists, Lipid-derived autoacoids</p> <p>Anti-asthmatic drugs: Types of bronchial asthma- acute, chronic, severe acute asthma (status asthmaticus) Classification of drugs, mechanism of action/pharmacological basis for the use, advantage and disadvantages of each group, adverse effects, drug interactions, contraindications and special features.</p>

		<p>Analgesic-antipyretic and anti-inflammatory agents [Nonsteroidal anti-inflammatory drugs (NSAIDs)]: Classification, salient features of various groups, Comparison of non-selective and COX II selective NSAIDs, adverse effects, uses, mechanism of action</p> <p>Drugs in treatment of rheumatoid arthritis: Classification of drugs, action, adverse effects and Limitations</p> <p>Gout- drug treatment: Pathophysiology of gout, Acute and chronic gout- drug treatment and prophylaxis</p>
5	<p>Hormones and Hormone Antagonists Introduction, Adenohypophyseal hormones and related substances, Thyroid and antithyroid drugs, estrogens and progestins, Androgens, Adrenocortical steroids and their synthetic analogs, Inhibitors of the synthesis and actions of adrenocortical hormones, Insulin, Oral hypoglycemic agents, Agents affecting calcification</p>	6 <p>Introduction, Adenohypophyseal hormones and related substances: Thyroid and antithyroid drugs: Review of biosynthesis and physiology of thyroid hormones, drugs for treatment of hypo and hyper thyroidism (thyroxin, Lugol's iodine solution, Carbimazole and propyl thiouracil)</p> <p>Estrogens and progestins: Classification, preparations and uses, Hormonal contraceptives (Types, Mechanism of action, uses, adverse effects and contra indications)</p> <p>Androgens: Preparations, uses, side effects Anabolic steroids, basis for use and misuse</p> <p>Adrenocortical steroids and their synthetic analogs: Review of synthesis, regulation and physiological actions Preparations with comparison of salient features (Mechanism of action, uses, adverse effects and contra indications)</p> <p>Insulin & Oral hypoglycemic agents: Diabetes Mellitus (Review, pathogenesis) Principle of Management, role of insulin and Oral anti diabetic drugs, List various preparations of insulin and compare salient features Discuss commonly used preparation under Mechanism of action, uses, adverse effects and contra indications</p>

			Agents affecting calcification: Action of Calcium, Vitamin D and Bisphosphonates, their uses, side effects
6	Vitamins Introduction, Water-soluble vitamins, Fat-soluble vitamins	3	Focus on List, uses, side effects of Vitamin A and Vitamin B-complex
7	Dermatological Pharmacology Corticosteroids, Retinoids, Photochemotherapy, Antimicrobial agents, Antifungal agents	3	No details required

Note (General suggestions): Management of some of the most common diseases e.g. Hypertension, Diabetes Mellitus, Bronchial asthma, Tuberculosis, HIV/AIDS, Glaucoma, Benign Hypertrophy of Prostate (BHP) etc should be included in Pharmacology III (PHL 411, Therapeutics and Toxicology) so that the Pharmacology knowledge application can be explained to our students.

In necessary conditions discussions on important and commonly used drugs, drug interactions, pharmacokinetics, contraindications, precautions and non pharmacological management should be focused.

Reference Books:

1. Joel G. Hardman, Lee E. Limbird and Alfred Goodman Gilman: *Goodman and Gilman's The Pharmacological*
2. *Basis of Therapeutics* (10th Ed.) 2001, McGraw-Hill, New York.
3. Bertram G. Katzung: *Basic and Clinical Pharmacology* (7th Ed.) 1998, Lange Medical Books/McGraw-Hill, New York.
4. H. P. Rang, M. M. Dale and J. M. Ritter: *Pharmacology* (4th Ed.) 1999, Churchill Livingstone, Edinburgh.

APL 331 (Credit hours 3)

**Anatomy and Physiology III
(Pathophysiology)
B. Pharm., Third Year, Fifth Semester**

Course Objectives:

This course will provide the students basic knowledge on pathophysiology of most common disease and basic clinical tests applied in their diagnostics.

Unit	Course Description	Hrs.	Details	Suggestion
1	Cardinal Manifestations and Presentation of Diseases Pain, Alterations in body temperature, Nervous system dysfunctions, Alterations in circulatory and respiratory functions, Alterations in gastrointestinal functions, Alterations in renal and urinary tract function, Hematologic alterations	4		
2	Genetics and Disease Chromosome disorders, Diseases caused by genetic defects of mitochondria, Gene therapy	3		
3	Oncology and Hematology Neoplastic disorders, disorders of hematopoiesis, disorders of hemostasis	3		
4	Infectious diseases Basic considerations, Clinical syndromes; community-acquired infections, Clinical syndromes: nosocomial infections, Bacterial diseases, Mycobacterial diseases, Spirochetal diseases, Ricketial, Mycoplasma and Chlamidia, Viral diseases, Fungal infections, Protozoal and helminthic infections	6	Bacterial diseases -Streptococcal infection, Diphtheria, Bordetella, gonococcus, pneumococcus, clostridium, E.coli, Viral diseases-HIV, hepatitis, Cytomegalo virus, Viral warts, Fungal infection-Candida infection, Protozoal infection-giardia, E. histolytica, Helminthic-Tapeworm, ascariasis, filarial,	
5	Disorders of the Cardiovascular System Disorders of rhythm, Disorders of the heart, Vascular Diseases	3		
6	Disorders of the Respiratory system Asthma, Environmental lung diseases, Pneumonia, Cystic fibrosis, Disorders of ventilation, Acute Respiratory Distress Syndrome, Mechanical ventilatory support	3	COPD, Hypoxia and oxygen therapy, cyanosis, dyspnoea, orthopnoea, bronchiectasis,	
7	Disorders of the Kidney and Urinary Tract Disturbances of renal function, Acute renal	3	introduction to disturbances in fluid and electrolyte balance,	

	failure, Chronic Renal failure, Transplantation, Urinary tract infections and obstruction		disturbances in acid base balance,	
8	Disorders of the Gastrointestinal System Disorders of the alimentary tract, Liver and biliary tract diseases, Disorders of pancreas	3	diarrhoea, vomiting, nausea, constipation, Acid peptic diseases, malabsorption by intestine-sprue, , disorder of exocrine pancreas, H. pylori infection,	5
9	Disorders of the Immune System, Connective Tissue and Joints Disorders of the immune system, Disorders of immune-mediated injury, Disorders of the joints	3		
10	Neurologic Disorders Diseases of the CNS, Disorders of Nerve and Muscles, Psychiatric disorders, Alcoholism and drug abuse	4	upper and lower motor neurons, pyramidal and extra pyramidal disorders, brainstem, cerebellar, spinal cord disorders, NMJ disorders like myesthesia gravis, cranial nerve disorders overview, depression, anxiety, psychosis, parkinsonism	6
11	Illnesses due to Poisons, Drug Overdosage and Envenomation Poisoning, Drug Overdosage, Reptila Bites, Ectoparasite infestations, Arthropod bites and stings	2		
12	Clinical Laboratory Tests General Principles, Hematological tests- RBCs, WBCs, Common serum enzyme tests: creatine kinase, lactate dehydrogenase, aklakaline phosphatase, Aspartate aminotransferase, alanine aminotransferase, Liver function tests: liver enzymes, serum bilirubin, cerum proteins, Urinalysis: appaearence, pH, specific gravity, protein, glucose, ketones, evaluation and microscopic examination, Common renal function tests: BUN, serum creatinine, creatinine clearance, Electrolytes: sodium, potassium, chloride, Minerals: calcium, phosphate, magnesium	8		

Reference Books:

1. Eugene Braunwald, Anthony S. Fauci, , Dennis L. Kasper, Stephen L Hauser, Dan L. Longo, and J. Larry Jameson: Harrison's Principles of Internal Medicine, Volume 1 and 2 (15th Ed.) 2001, McGraw Hill, New York.
2. Harsh Mohan: Textbook of Pathology (4th Ed.) 2000, Jaypee Brothers Medical Publishers, New Delhi.
3. Leon Shargel, Alan H. Mutnick, Paul F. Souney and Larry N. Swanson: Comprehensive Pharmacy Review (5th Ed.) 2004, Lippincott Williams & Wilkins, Philadelphia.

PHC 371(Credit hours 3)

Pharmaceutical Chemistry VI
(Name Reactions)
B. Pharm., Third Year, Fifth Semester

Course Contents:

45 hours

Introductory study of glossary of at least 40 name reactions with their application in relevant field of pharmaceuticals, their simple mechanism and utilities of the synthetic reagents involved therein under the heading of reaction types

Unit	Course Description	Hrs.	Details
1	Condensation		1. Aldol crossed Aldol 2. Claisen crossed claisa 3. Perkin 4. Mannich 5. Michael 6. Robinson-annulation 7. Darzen 8. Dieckmann 9. Knoevenagel
2	Oxidation-reduction		1. Birch reduction 2. Clemmensen reduction 3. Wolf-kishner reduction 4. meerwein Ponndorf Verley reduction 5. Baeyer-villigar oxidation 6. Cannizaro 7. Jones Oxidation 8. KMnO ₄ Oxidation 9. Peroxide oxidation 10. SeO ₂ Oxidation
3	Rearrangement		1. Claisen rearrangement 2. Pinacol-pinacolone 3. Hofmann bromide 4. Fries 5. Favorskii 6. Beckmann 7. Dienone-phenol
4	Substitutions		1. S _N 1 and S _N 2 2. Aromatic Sulphonation 3. Aromatic Nitration 4. Chlorination 5. Friedel Craft's alkylation 6. Friedel Craft's Acylation
5	Addition		1. Wittig reaction 2. Oxymercuration-demercuration

			3. Catalytic hydrogenation
6	Elimination		1. Cope 2. E1 and E2 reaction 3. Shapiro reaction 4. Bamford-Stevens reaction 5. Hofmann elimination

Reference Books:

1. Jerry March: *Advanced Organic Chemistry* (4th Ed.) 1999, John Wiley and Sons, New York.
2. Robert Thorton Morrison and Robert Neilson Boyd: *Organic Chemistry* (6th Ed.) 1999, Prentice Hall of India, New Delhi.
3. Peter Sykes: *Mechanisms in Organic Chemistry* (6th Ed.) 2000, Orient Longman, New Delhi.
4. Sanyal Name Reaction

PHG 381 (Credit hours 3)

**Pharmacognosy IV
(Natural Products Chemistry)
B. Pharm., Third Year, Fifth Semester**

Course Objectives:

The student will become familiar with pharmacognostic principles of natural product chemistry applied in the development of drugs from natural (plant) origin.

Unit	Course Description	Hrs.
1	Discovering New Drugs from Higher Plants by Pharmacological Screening Introduction, Principles, Problems, Perspectives	3
2	Pharmacological Screening Programs for Plant Extracts Random selection approach, Selection of plants containing specific types of chemical compounds, Selection of plants based on a combination of criteria, Ideal requirements for a primary screen, Multidimensional primary screening, Multidimensional secondary screening of extracts and pure compounds, Tertiary evaluation, Computerized programs, Problems: sample variation, unexpected dose-response relationship, variation within sample, failures to achieve positive results, Prospects for the future	12
3	Experimental and Clinical Data for Antitumor and Cytotoxic Agents from Plants Terpenoids, Miscellaneous Compounds, Alkaloids, Others	3
4	Recent Advances in the Field of Antibiotics Acetate/propionate-derived metabolites, Isoprenoid metabolites, Amino acid-derived metabolites, Genetic engineering	3
5	Plant Mono-, Di- and Sesquiterpenoids with Pharmacological Activities General biological properties, Monoterpenes, Sesquiterpenes and Diterpenes	4
6	Saponins with Biological and Pharmacological Activity Saponins of different plant origins, General properties, Future	3
7	Principles Related to the Commercial Production, Quality and Standardization of Natural Products Commerce in crude drugs, Production of crude drugs, Plant growth regulators, Plant cell and tissue culture; biological conversions; clonal propagation, Phytochemical variation within a species, Detoriation of stored drugs, Quality control	8
8	The Modification of Natural Substances in the Modern Drug Synthesis Steroids and prostanoids, Chemotherapy, Claviceps Purpurea, Opiates, Cannabinoids, Natural substances as raw material for drug synthesis	6
9	Current Trends Plant products and High Throughput, Biologically active compounds from marine organisms, Traditional plant medicine as a source of new drugs	3

Reference Books:

1. H. Wagner and P. Wolff: *New Natural Products and Plant Drugs with Pharmacological, Biological or Therapeutical Activity*, 1977, Springer-Verlag, Berlin.
2. W. C. Evans: *Trease and Evans Pharmacognosy* (15th Ed.) 2002, W. B. Saunders, Edinburgh.
3. Hans-Joachim Boehm, Gerhard Klebe and Hugo Kubinyi: *Wirkstoffdesign, Der Weg zum Arzneimittel*, 2002, Spektrum Akademischer Verlag, Heidelberg, (in German).
4. Paul M. Dewick: *Medicinal Natural Products, A Biosynthetic Approach* (2nd Ed.) 2002, J. Wiley and Sons, Chichester

LAB 11 (Credit hours 1)

Pharmaceutical Laboratory-11 (Pharmaceutics)

B. Pharm., Third Year, Fifth Semester

Course Objectives:

The student will become familiar with the basic principles of pharmacokinetic and pharmacodynamic in vitro (laboratory) conditions

Course Content:

- | | |
|--|---------------------------------------|
| 1. Tablet dissolution rate | 2. Partition coefficient |
| 3. Accelerated stability testing | 4. Hydrolysis in parenterals |
| 5. Adsorption processes | 6. Time constants in pharmacokinetics |
| 7. AUC determination | 8. Bioequivalence studies |
| 9. Half-exchange method (<i>in vitro</i> determination) | |

LAB 12 (Credit hours 1)

Pharmaceutical Laboratory-12 (Pharmaceutical Microbiology)

B. Pharm., Third Year, Fifth Semester

Course Objectives:

The student will become familiar with the basic microbiological techniques and tests.

Course Content:

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|--|--|
| 1. Measurements of antimicrobial activity | 2. Antibiotic assays – agar diffusion assays |
| 3. Antibiotic assays – turbidimetric assays | 4. MIC test methods |
| 5. Counting of microorganism in given pharmaceutical products (at least three) | |
| 6. Preservative efficacy tests | 7. Disinfectant evaluation |
| 8. Interpretation of results according to Pharmacopoeial requirements and statistical evaluation | |
| 9. Microbiological assay of vitamins | |

Reference book:

W. B. Hugo and A. D. Russel: *Pharmaceutical Microbiology* (6th Ed.) 1998, Blackwell Scientific Publication, Oxford.

LAB 13 (Credit hours 1)

Pharmaceutical Laboratory-13 (Instrumental Analysis)

B. Pharm., Third Year, Fifth Semester

Course Objectives: *The student will become familiar with the basic analytical instruments*

Course Content:

- | | |
|---------------------|-----------------|
| 1. pH Meter | 2. Conductivity |
| 3. Potentiometry | 4. Colourimetry |
| 5. UV | 6. HPLC |
| 7. Flame Photometer | |

Reference book:

Kenneth A. Connors: *Textbook of Pharmaceutical Analysis* (3rd Ed.) 2002, John Wiley and Sons, New York.

SEM-4 (Credit hour 1)

Pharmaceutical Seminar-4

B. Pharm., Third Year, Fifth Semester

THIRD YEAR

SIXTH SEMESTER

SIXTH SEMESTER

Code	Description	Credit hours	Pre-requisite course	Core Course
PHT 303	Pharmaceutics VIII (Industrial Pharmacy)	3	PHT 302	☼
PHT 304	Pharmaceutics IX (Hospital Pharmacy)	3	-----	☼
PHL 312	Pharmacology II (Therapeutics)	3	PHL 311	☼
PHC 372	Pharmaceutical Chemistry VII (Quality Assurance of Drugs)	3	PHC 371	☼
PHC 373	Medicinal Chemistry I (Natural Drug)	3	PHG 381	☼
PHG 382	Pharmacognosy V (Himalayan Crude Drugs)	3	PHG 181	☼
LAB-14	Pharmaceutical Laboratory 14	1	.....	.....
LAB-15	Pharmaceutical Laboratory 15	1	.....	.....
LAB-16	Pharmaceutical Laboratory 16	1	.....	.....
SEM-5	Pharmaceutical Seminar-5	1	.....	.....
TOTAL		22		

PHT 303 (Credit hours 3)

**Pharmaceutics VIII
(Industrial Pharmacy)**

B. Pharm., Third Year, Sixth Semester

Course Objectives:

Through this course the student will learn the principles of industrial production of drugs, scale-up processes and packaging materials used in drug industry.

Unit	Course Description	Hours	Details	Suggestions
1.	Principles of Pharmaceutical Processing	6		
	Mixing, Milling, drying, Compression and consolidation of powdered solids, Basic chemical principles related to emulsion and suspension dosage forms, Pharmaceutical reology, Clarification and filtration		Mixing, Milling, drying, Compression and consolidation of powdered solids, Basic chemical principles related to emulsion and suspension dosage forms, Pharmaceutical reology, Clarification and filtration	<i>Few units of this chapter can be removed as they have already been covered in Pharmaceutics-VII</i>
2.	Preformulation Testing	4		
	Organoleptic properties, Purity, Particle size, shape and surface area solubility, Dissolution, Parameters affecting absorption, Crystal properties and polymorphism, Stability, Miscellaneous properties, Examples of preformulation studies		Preformulation considerations: Preliminary evaluation and molecular optimization, Bulk characterization, material crystallinity, polymorphism. Thermal properties, hygroscopicity. Particle characterization, bulk density, powder flow properties, solubility analysis, p^{Ka} determination, pH, solubility profile, effect of temperature, solubilization, partition coefficient, dissolution, stability analysis, solution stability and solid state stability.	
3.	Pharmaceutical Dosage Form Design -Tablets	10		
	Tablet formulation and		Powder and granules: Reasons for granulation, properties of	

	design, Compressed tablets by wet granulation, Compressed tablets by direct compression, Compression-coated and layer tablets, Effervescent tablets, Special tablets, Chewable tablets, Medicated lozenges, Quality assurance		granules, size, shape, surface area, density strength and friability, Pharmaceutical granulation equipment; Wet and dry granulators, granulation methods; wet and dry granulation methods, direct compression methods effect of granulation method on granule structure. Tablet formulation: Definitions and classification, advantages and disadvantages, properties of tablets, formulation of tablets, modern tableting excipients, directly compressible vehicles, Manufacturing of tablets, effervescent tablets, compression coated tablets, chewable tablets, common problems in tableting process. Evaluation of tablets: Hardness measurement, weight variation tests, thickness and diameter, friability, disintegration time, dissolution time, mechanism of tablet disintegration and dissolution, in process quality control Tablet compression machines and tooling: Types of tablet tooling, steel selection, maintenance and storage of tooling. Tablet coating: Definitions and classification of coating methods, advantages of coating methods, different methods of coating, sugarcoating, film coating, enteric coating.	
4.	Pharmaceutical Dosage Form Design –Capsules	4		
	Hard capsules, Soft gelatin capsules, Microencapsulation		Hard gelatin capsules: Definitions, classification advantages and limitation of capsule dosages form, gelatin and its manufacturing, manufacturing of hard capsule shell, properties and formulation of capsule,	

			<p>capsule filling machine, tooling accessories, manufacturing problems, quality control and packaging.</p> <p>Soft gelatin capsule: Definitions, classification advantages and limitation of capsule manufacturing of soft capsule, properties and formulation of capsule, manufacturing problems, quality control and packaging.</p> <p>Micro encapsulation Technology: Purpose, Types of microencapsules, importance of microencapsulation in Pharmacy, techniques of microencapsulation, evaluation of microencapsules.</p>	
5.	Sustained Release Dosage Forms	5		
	Design, Zero-order release, First-order release, Multiple dosing, Approaches based on drug modification, Approaches based on dosage form modification, Product evaluation and testing, Drug complexes, Granules, Matrix tablets, Controlled release technology		Sustained release drug delivery systems: Principles, advantages, limitations and type of SR dosage forms, Zero-order release, First-order release, Multiple dosing, methods of obtaining SR effect of drugs. Matrix & Reservoir Systems, Controlled Release Technology. Formulation and manufacturing of SR matrix tablets, drug release from SR dosage forms, evaluation of SRDF, Excipients used in SRDF, Dose calculation.	
6.	Pharmaceutical Dosage Form Design – Others	6		
	Liquids, Pharmaceutical suspensions, Emulsions, Semisolids, Suppositories, Pharmaceutical aerosols, Sterile products		<p>Liquid dosages forms: Solution and elixirs, theory of solution, different factors affecting solution process, packaging of liquids, preservation and stability, quality control system of liquid.</p> <p>Suspensions: Advantages and disadvantages of suspension, theoretical considerations, aggregated and dispersed systems, formulation, manufacturing, stability, evaluation and quality</p>	<i>Semisolids, Suppositories, Pharmaceutical aerosols have already been included in the 2nd Year 2nd Semester. So, it is better to remove from here.</i>

			<p>control, rheological considerations, illustrative example.</p> <p>Emulsions: Definitions, applications, advantages, disadvantages, theory, formation, classification of emulsifying agent, formulation, manufacturing, stability, evaluation and quality system, rheological consideration, illustrative examples.</p> <p>Sterile products: Definitions and classifications, Formulation considerations; vehicles and additives, containers, manufacturing consideration. Environment, manufacturing techniques, raw materials and machines, quality control, sterility tests, pyrogen test, clarity test, leak test for ampoules and packaging of parenteral products.</p>	
7.	Product Processing, Packaging, Evaluation and Regulation	10		
	<p>Pilot plant scale-up techniques, Packaging materials science, Production management, Kinetic principles and stability testing, Quality control and Assurance, Drug regulatory affairs</p>		<p>Pilot plant scale-up techniques and their applications. Design, development, production, components and Design, development and process validation methods for pharmaceutical operations. Kinetic principles & their role in formulation development. Quality control and Assurance, IPQC, Drug regulatory affairs: GMP, Total Quality Management and Quality Assurance, Quality Audit. Design of a pharmaceutical manufacturing plant in keeping with GMP guidelines. Stabilization and stability testing protocol for various pharmaceutical products.</p>	

			<p>Evaluation of controlled release formulation.</p> <p>Packaging technology: Purpose of packaging, Properties of packaging materials, factors influencing choice of packaging, advantages and disadvantages of packaging materials, glass, and glass containers, metal and metal containers, plastic and plastic containers, films, foils and laminates, rubber based materials, closures, tamper resistant packaging, testing and quality assurance of packaging materials, different packing machine, and accessories, organization of packaging line, labeling.</p>	
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Reference Books:

1. Leon Lachman, Herbert A. Lieberman and Joseph L. Kanig: *The Theory and Practice of Industrial Pharmacy* (3rd Ed.) 1987, Varghese Publishing House, Bombay.
2. Sidney H. Willig: *Good Manufacturing Practices in Pharmaceuticals* (5th Ed.) 2001, Marcel Dekker, New York.
3. Herbert A. Lieberman, Leon Lachman and Joseph B. Schwartz: *Pharmaceutical Dosage Forms: Tablets*, Volume 1 1989, Marcel Dekker, New York.
4. Herbert A. Lieberman, Leon Lachman and Joseph B. Schwartz: *Pharmaceutical Dosage Forms: Tablets*, Volume 2 1990, Marcel Dekker, New York.
5. Herbert A. Lieberman, Martin M. Rieger and Gilbert S. Banker: *Pharmaceutical Dosage Forms: Disperse Systems*, Volume 3 1998, Marcel Dekker, New York.

PHT 304 (Credit hours 3)

**Pharmaceutics IX
(Hospital Pharmacy)**

B. Pharm., Third Year, Sixth Semester

Course Objectives:

The students will become familiar with the organization and specificity of hospital pharmacy, responsibilities and duties of hospital pharmacist, as well as drug monitoring processes in hospital.

Unit	Course Description	Hours	Details	Suggestion
1.	Hospital Organization	8		
	The hospital, Uniqueness of hospital pharmacy, Patients self-administration of drugs in hospitals, Investigational drugs, Store room arrangements, Emergency and antidotal cabinet, Poison control, Narcotics, Radiopharmaceuticals, Regulations, Technology and automation in hospital pharmacy, Future practice		The hospital – Definition, Functions, Classifications, Organization, Management Uniqueness (ideal) HP: Function and Objectives Location, Layout, Personal Flowchart of Materials' and Responsibilities. Patient self administration of drugs in hospitals –drugs dispensed without prescription and non-prescriptive drugs available in nursing station Investigational drug – availability, handling, distribution system Store room arrangements – Layout, Types of Materials Stocked Emergency and antidotal cabinet. Drug stock in ward (nursing station) Role of hospital pharmacist on poison control Handling of Narcotics (in pharmacy), Radio Pharmaceuticals Technology and automation in hospital Pharmacy. DTC and role of a hospital pharmacist in hospital. Hospital pharmacy practices in Nepal.	
2.	Responsibilities of Hospital Pharmacist	14		
	Standards of practice,		Standard of practice (SOP of	

	Dispensing to in-door and out-door patients, Intravenous admixtures, Cytotoxic drugs dispensing, Handling of radiopharmaceuticals, Sterile production, Hospital Formulary, Prepackaging and manufacturing in hospital, Computers in hospital pharmacy		practice) Dispensing in door – Individual Prescription order system, Complete floor stock system, Combination of 1 and 2, Unit dose dispensing. Out Patient - Emergency out Patient, Referred out Patient, Ambulatory Patient IV admixture: Addition and dilution of IV fluids. Handling and dispensing of cytotoxic and radiopharmaceuticals. Sterile Production in hospital. Hospital Formulary – System and organization, Guiding Principles, Content of formulary, Preparation of formulary. Prepackaging and manufacturing in hospital concept of Prepackaging, Policy, Standardization and design Manufacturing – Sterile Manufacturing, Non Sterile Manufactures.	
3.	Adverse Drug Reaction	6		
	Incidence and scope of the problem, Causes and classification, Impact on health-care costs, Monitoring and prevention		Incidence and scope of the problem, Causes and classification, Impact on health-care costs, Monitoring and prevention Incidence and causes, classification, Impact, Monitoring.	
4.	Long-Term Care Facilities	4		
	Background, The right to health, Impact of growing elderly population, Long-term care facilities, Extended-care facilities, Skilled nursing facilities, Intermediate care facilities, Care of mentally retarded, Pharmacist role and			Refer Winfielder A J

	functions			
5.	Nutrition and the Hospitalized Patient	6		
	Nutritional problems in hospitalized patients, Nutritional assessment and metabolic requirements, methods of support, monitoring support, Disease-specific support, Home parenteral nutrition		Nutritional deficiency states, nutritional problems in hospitalized patients, Nutritional assessment and metabolic requirements, Methods of support, Monitoring support, Disease-specific support, Home parenteral nutrition. TPN and preparation of TPN.	
6.	Surgical Supplies	3		
	Surgical dressings, Sutures and suture materials		Classification, Types of Sutures and suture materials, also gauze bandages and CSSD and its functions	
7.	Health Accessories in Hospital Practice	4		
	Hospital beds, Respiratory therapy, Apnea programs, Phototherapy, Hypodermic equipments, Bulb syringes, Dressings and first-aid supplies, Thermometers, Blood-pressure monitors, Blood-glucose monitors, Breast pumps, Vacuum constriction devices, Ostomy appliances and supplies, Urology and incontinence supplies			

Reference Books:

1. Alfonso R. Gennaro: *Remington: the Science and Practice of Pharmacy*, Volume II (20th Ed.) 2002, Lippincott Williams & Wilkins, Philadelphia.
2. William E. Hassan: *Hospital Pharmacy* (5th Ed.) 1986, Lea and Febiger, Philadelphia.
3. Roger Walker and Clive Edwards: *Clinical Pharmacy and Therapeutics* (3rd Ed.) 2003, Churchill Livingstone, London.
4. Leon Shargel, Alan H. Mutnick, Paul F. Souney and Larry N. Swanson: *Comprehensive Pharmacy Review* (5th Ed.) 2004, Lippincott Williams & Wilkins, Philadelphia.

**Pharmacology II
(Therapeutics)**

B. Pharm., Third Year, Sixth Semester

Course Objectives:

The students will become familiar with pharmacological principles of therapeutics, and pharmacology of drugs acting on specific systems/organs in the body (II)

Unit	Course Description	Hours	Details	Suggestions
1.	<p>Drugs Affecting Renal Function and Electrolyte Metabolism</p> <p>Diuretics and other agents employed in the mobilization of edema fluid, Agents affecting the renal conservation of water, Inhibitors of tubular transport of organic compounds</p>	6	<p>Diuretics: Classification; Mechanism of Action, Indications, Adverse Effects and Contraindications</p> <p>Antidiuretics: List of drugs their indications, Adverse Effects and Contraindications. Drugs for Diabetes insipidus</p>	
2.	<p>Cardiovascular Drugs</p> <p>Renin and angiotensin, Drugs used for the treatment of angina: organic nitrates, calcium-channel blockers and β-adrenergic antagonists, Antihypertensive agents and the drug therapy of hypertension, Digitalis and allied cardiac glycosides, Antiarrhythmic drugs, Drugs used in the treatment of hyperlipoproteinemias</p>	10	<p>Renin and angiotensin: Brief overview (<i>Revision</i>) Renin Angiotensin Aldosterone System, ACE Inhibitors & Angiotensin Receptor Blockers (<i>Classification, Mechanism of action, Adverse effects, Contraindications, Therapeutic Uses and Drug interactions</i>)</p> <p>Calcium-channel blockers: Dihydropyridine & non dihydropyridine group (<i>Classification, Mechanism of action, Adverse effects, Contraindications, Therapeutic Uses and Drug interactions</i>)</p> <p>Drugs used for the treatment of angina: Types of angina; Classification, Mechanism of action, Adverse effects, Contraindications, Therapeutic Uses and Drug interactions</p>	Teaching hours should be increased to 12 hours.

			<p>(including nitrates and Sildenafil), Rational of combination therapy</p> <p>Antihypertensive agents: Classification, rationale for use, mechanism of action, indications, adverse effects, contraindication and drug interaction</p> <p>Therapy of hypertension: Introduction and grading, Principle of therapy (<i>non-pharmacological, pharmacological, combination therapy</i>)</p> <p>Digitalis and allied cardiac glycosides: Congestive heart failure and its types, drugs for CHF (<i>Classification, mechanism of action, adverse effects, therapeutic uses and drug interactions</i>), Present status of Digitalis in CHF</p> <p>Antiarrhythmic drugs: Classification (<i>According to clinical use and mechanism of action</i>), Briefly discuss about the commonly used drugs e.g. Lignocaine, Adenosine, Verapamil etc</p> <p>Drugs used in the treatment of hyperlipoproteinemias: Classification, Mechanism of action, Adverse effects, Contraindications, Therapeutic Uses and Drug interactions</p>	
3.	<p>Drugs Affecting Gastrointestinal Function</p> <p>Agents for control of gastric acidity and</p>	4	<p>Agents for control of gastric acidity and treatment of peptic ulcers: Introduction, pathogenesis, drugs (<i>classification, mechanism of action</i>)</p>	<p>Peptic ulcer disease is very common so should be</p>

	treatment of peptic ulcers, Agents affecting gastrointestinal water flux and motility, digestants and bile acids		<p><i>uses, adverse effects and drug interactions</i>) & non-drug measures for peptic ulcer diseases and regime for <i>H.pylori</i> eradication</p> <p>Agents affecting gastrointestinal water flux and motility:</p> <ul style="list-style-type: none"> - Therapy of nausea and vomiting (<i>Classification, mechanism of action, uses, adverse effects and drug interactions</i>) - Therapy of diarrhoea (<i>Oral rehydration solution - constituents, indications</i>), Non-specific antidiarrhoeals and antispasmodics (<i>list</i>), Non-drug treatment - Therapy of constipation (<i>Commonly used drugs in constipation, clinical importance, adverse actions</i>), Non-drug treatment. <p>Digestants and bile acids</p>	covered in detail. Teaching hours should be increased to 5 hours. Drugs for diarrhea, constipation & emesis should be clearly mentioned
4.	<p>Drugs Affecting Uterine Motility</p> <p>Oxytocin, Prostaglandins, Ergot alkaloids and other drugs, Tocolytic agents</p>	2	Mechanism of actions, uses, adverse effects	Those Prostaglandins which are used as Abortifacient (affecting uterine motility)
5.	<p>Chemotherapy of Parasitic Infections</p> <p>Drugs used in the chemotherapy of helminthiasis, Drugs used in the chemotherapy of protozoal infections - malaria, Drugs used in the chemotherapy of protozoal infections – amebiasis, giardiasis and</p>	6	Mechanism of actions, uses, adverse effects, dose. For leishmaniasis: stibogluconate and pentamidine should be covered.	

	trichomoniasis, Drugs used in the chemotherapy of protozoal infections – leishmaniasis, trypanosomiasis and other protozoal infections			
6.	Chemotherapy of Microbial Diseases Antimicrobial agents – general considerations, Antimicrobial agents – sulfonamides, trimethoprim-sulfamethoxazole, Quinolones and agents for urinary tract infections, Antimicrobial agents- penicillins, cephalosporines and other betalactam antibiotics, Antimicrobial agents – aminoglycosides, Antimicrobial agents – tetracyclines, Chloramphenicol, Erythromycin and miscellaneous antibacterial agents, Drugs used in the chemotherapy of tuberculosis and leprosy, Antifungal agents, Antiviral agents	10	<p>General principles</p> <ul style="list-style-type: none"> • Classification, Mechanism of action, Adverse effects, Contraindications, Therapeutic Uses, usual dose & Drug interactions of <ul style="list-style-type: none"> ▪ Cotrimoxazole, sulphonamides. ▪ Quinolones. ▪ β-lactam antibiotics: penicillins, cephalosporins etc and list of β-lactamase inhibitors, Rational of combining with β-lactams. ▪ Aminoglycosides: list of important drugs (<i>Streptomycin, gentamicin, amikacin, netilmicin, tobramycin, neomycin</i>) general features, mechanisms, kinetics, adverse effects, comparison of clinically most useful preparations. ▪ Tetracyclines, chloramphenicol. ▪ Macrolides (<i>Erythromycin as prototype</i>) ▪ Miscellaneous groups of antibiotics: very brief discussion, e.g. bacitracin, vancomycin, clindamycin, polymyxin-B, spectinomycin. 	Antimicrobials including antifungal should be shifted from Pharmacology I (V sem) to here, as these portions are covered in detail here. Teaching hours should be increased to 14 hours.

			<ul style="list-style-type: none"> • Agents for urinary tract infections: Common organisms causing UTI and review of antimicrobial of choice, Define and list urinary antiseptics & urinary analgesics. • Drugs used in the chemotherapy of tuberculosis: Classification and Comparison between primary and secondary antitubercular drugs, Multi drug therapy regimens for tuberculosis Discussion of individual drugs, List of drugs used in resistant tuberculosis • Drugs used in the chemotherapy of leprosy: Classification of drugs, multiple drug therapy, Discussion of individual drugs • Antifungal Agents: Classification, Mechanism of action, Adverse effects, Contraindications, Therapeutic Uses • Antiviral Agents: Retroviral and nonretroviral (<i>Classification, Mechanism of action, Adverse effects, Contraindications, Therapeutic Uses</i>), Therapy for HIV (HAART) 	
7.	Chemotherapy of Neoplastic Diseases Introduction, Antineoplastic agents	3	General principles, Classification of drugs, mechanism of action, General adverse effects of anti-cancer drugs,	

8.	Drugs used for Immunosuppression Immunosuppressive agents	2	Classification, mechanism of action, possible adverse effects, uses and contraindication	
9.	Drugs Acting on the Blood and Blood-forming Organs Hematopoietic agents: growth factors, minerals and vitamins, Anticoagulant, thrombolytic and antiplatelet drugs	2	<p>Hematopoietic agents: growth factors, minerals and vitamins:</p> <ul style="list-style-type: none"> ▪ Iron Preparations (<i>oral and parenteral</i>), indications, adverse effects, treatment of overdose ▪ Folic acid and vitamin B12: Preparations, actions, uses, inter-relationship between folic acid and vitamin B12 . ▪ Vitamin K and Coagulants, their action and uses <p>Anticoagulant: Classification, Mechanism of action, Adverse effects, Contraindications, Therapeutic Uses and Drug interactions</p> <p>Thrombolytic: Preparations, pharmacological basis for their actions and related usefulness, List of anti-thrombolytic agent and its uses</p> <p>Antiplatelet drugs: Classification, Mechanism of action, Adverse effects, Contraindications, Therapeutic Uses.</p>	Vitamin has already covered in Vth Sem. Teaching hours shall be increased (Vit K & folic acid should be covered here in place of Vth semester) to 5 hours

Note (General suggestions): Management of some of the most common diseases e.g. Hypertension, Diabetes Mellitus, Bronchial asthma, Tuberculosis, HIV/AIDS, Glaucoma, Benign Hypertrophy of Prostate (BHP) etc should be included in Pharmacology III (PHL 411, Therapeutics and Toxicology) so that the Pharmacology knowledge application can be explained to our students.

Reference Books:

1. Joel G. Hardman, Lee E. Limbird and Alfred Goodman Gilman: *Goodman and Gilman's The Pharmacological Basis of Therapeutics*, McGraw-Hill, New York.
2. Bertram G. Katzung: *Basic and Clinical Pharmacology* (7th Ed.) 1998, Lange Medical Books/McGraw-Hill, New York.
3. H. P. Rang, M. M. Dale and J. M. Ritter: *Pharmacology* (4th Ed.) 1999, Churchill Livingstone, Edinburgh. 49

Suggestion: Latest edition of the books should be recommended.

PHC 372 (Credit hours 3)

Pharmaceutical Chemistry
(Quality Assurance of Drugs)
 B. Pharm., Third Year, Sixth Semester

Course Objectives:

The students will learn the principles of quality control of drugs, Pharmacopoeial assays used in quality assurance, GMP and GLP principles, ISO standardization and WHO guidelines regarding quality assurance of drugs.

Unit	Course Description	Hours	Details	Suggestions
1.	Quality Control of Drugs	3		
	Basic principles, Testing, Properties of drug substances, Assurance of quality		Concept and definitions of Quality, Parameters of quality of a medicine (drug), Principle of QA, Principles of GMP, TQM, Definitions of GLP and GCP.	
2.	Pharmacopoeial Assays for Quality Assurance of Drugs	12		
	Assays for acidimetry and alkalimetry, Non-aqueous titrations, Oxidation-reduction assays, Assays by diazotization, Assays by precipitation, Complexometric assays, Gravimetric assays, Gasometric assays, Photometric assays, Assays for esters, volatile oils etc, Alkaloidal assays, Assays by the oxygen flask method, Radiochemical assays, Miscellaneous assays, Assays for biologicals		Definition with chemical reaction and pharmaceutical applications of each assay method.	
3.	Methods Applied in Quality Testing	10		
	UV and visible spectrophotometry, Fluorimetry, IR spectrophotometry, NMR, Mass spectrometry, Flame photometry, Emission		Working principle, Instrumentation, operation and Pharmaceutical applications of the each quality testing equipment.	

	spectroscopy, X-ray diffraction, Radioimmunoassay, HPLC, TLC, Biological activity assays			
4.	GMP and GLP	10		
	GMP practices as per WHO guidelines, USFDA guidelines, Documentation of quality system, Approach to certification, Application for registration, Quality audit, Quality manual for operation, Quality policy, Planning		GMP Based on WHO guidelines: Basic Requirements of GMP, Essential Elements of GMP, Sanitation and Hygiene, Complaint handling and recall, Contract Production and Analysis, Self-inspection and quality audits, Personnel Key Personnel Training, Equipments Materials (Starting Materials, Packaging materials, Intermediate and bulk products , Finished products, Rejected, reworked and recovered materials, Rejected materials and products, Rework and recovery, Recalled products and returned goods, Reagents and culture media, Reference standards, Waste materials, Miscellaneous materials) Documentation (label, master formulae, Batch processing Record, Batch packaging record, SOPs) Approach to certification, Application for registration, Quality audit, Quality manual for operation, Quality policy, Planning, GCP, GLP cGMP and USFDA guidelines.	GCP, GLP should be maintained in the syllabus contents.
5.	Validation	5		
	Quality assurance, Validation of drug substances and reagents, Validation of equipment and analytical instruments, Validation of final products, Cost audit		Design qualification (DQ), Installation Qualification (IQ), Operational Qualification (OQ) , Performance Qualification (PQ) Validation of drug substances and reagents, Validation of equipment and analytical instruments	

			Validations (Prospective, Concurrent, Retrospective) Cleaning Validation, Change control, Re-Validation, Risk analysis, Cost audit, Standard cost accounting	
6.	ISO 9000 Series and ICH Guidelines	5		
	Elements and applications of ISO 9000 systems, ISO Guide 17025, Documentation, Nepalese standards		Introduction to ISO, ISO 9000 system, ISO 17025, Principles of ISO, Introduction to ICH, Introduction to the ICH Quality, safety Efficacy and Multidisciplinary Guidelines, Documentation for accreditation.(Quality Manual, Procedures Quality Records) Nepal Bureau of Standards and Metrology, NS Mark and licensing process.	

Reference Books:

1. Quality Assurance of Pharmaceuticals: A Compendium and Related Materials, Vol. 1-2, 1997, WHO Publications.
2. L. M. Atherden: *Bently and Driver's Textbook of Pharmaceutical Chemistry* (8th Ed.) 2001, Oxford University Press, New Delhi.
3. Kenneth A. Connors: *A Textbook of Pharmaceutical Analysis* (3rd Ed.) 2002, John Wiley and Sons, New York.
4. Sidney H. Willig: *Good Manufacturing Practices in Pharmaceuticals* (5th Ed.) 2001, Marcel Dekker, New York.
5. Alfonso R. Gennaro: *Remington: the Science and Practice of Pharmacy*, Volume I (20th Ed.) 2002, Lippincott Williams & Wilkins, Philadelphia.
6. 6. ICH Harmonized Guidelines and WHO on Harmonization 7. ISO 9000 series

PHC 373 (Credit hours 3)

Medicinal Chemistry I
(Natural Drugs)
B. Pharm., Third Year, Sixth Semester

Course Objectives:

In this course the students will learn principles of medicinal chemistry, properties of drugs affecting their biological action and therapeutic application for drugs of natural origin. (I)

Unit	Course Description	Hours	Details	Suggestions
1.	Introduction to Medicinal Chemistry	6		
	Drug discovery, Theoretic aspects of drug design, Medicines of plant origin, Synthetic and semisynthetic drugs, Drugs of natural origin, Rational design, Genetic engineering			
2.	Physicochemical Properties in Relation to Biological Action	8		
	Receptors and drug action, Drug distribution, Acid-base properties, Statistical prediction of pharmacological activity, Combinatorial chemistry, Molecular modeling (Computer-aided drug design)			
3.	Metabolic Changes of Drugs and Related Organic Compounds	4		
	Role of cytochrome P-450 monooxygenase in oxidative biotransformation, Oxidative reactions, Reductive reactions, Hydrolytic reactions, Phase II or conjugation reactions, Factors affecting drug metabolism			
4.	Classification, Chemistry, Biological Action and Therapeutic Application of the following: Alkaloids	4		
	Solanaceous alkaloids, Ephedrine, Nicotine, Quinine, Morphine, General methods of structure determination			

5.	Steroids and Therapeutically Related Compounds	4		
	Chemical and physical properties of steroids, Changes to modify pharmacokinetic properties of steroids, Cholesterol and bile acids, Androgens, Estrogens, Progestins, Cortisone and hydrocortisone			
6.	Prostaglandins, Leukotriens and other Eicosanoids	4		
	Eicosanoid biosynthesis, Drug action mediated by eicosanoids, Drug design			
7.	Carbohydrates	4		
	Stereochemical considerations, Interrelationship with lipids and proteins, Sugar alcohols, Sugars, Starch and derivatives, Cellulose derivatives, Heparin, Glycosides			
8.	Amino Acids, Proteins, Enzymes and Peptide Hormones	4		
	Aminoacids, Protein hydrolysates, Amino acid solutions, Protein and protein-like compounds, Enzymes, Hormones			
9.	Vitamins and Related Compounds	4		
10.	Cardiac Glycosides	3		
	Digitalis, Strophanthus group			

Reference Books:

1. William O. Foye, Thomas L. Lemke and David A Williams: *Principles of Medicinal Chemistry* (4th Ed.) 1995, Lippincott Williams and Wilkins, Philadelphia.
2. Jaime N. Delgado and William A. Remers: *Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry* (10th Ed.) 1998, Lippincott-Raven Publishers, Philadelphia.
3. Hans-Joachim Boehm, Gerhard Klebe and Hugo Kubinyi: *Wirkstoffdesign, Der Weg zum Arzneimittel*, Spektrum Akademischer Verlag, Heidelberg, 2002. (in German)

4. PHG 382 (Credit hours 3)

Pharmacognosy V (Himalayan Crude Drugs)

B. Pharm., Third Year, Sixth Semester

Course Objectives:

This course will provide students with knowledge on Himalayan crude drugs traditionally used in local healing traditions.

Course Contents: 45 hours

Studies on at least 30 Natural Drugs available and used in Nepal (Self Directive course)
Nomenclature, Biological Source, Habitat, Cultivation and Collection, Macroscopical Characters, Microscopical Characters, Chemical constituents, Pharmacological action, Pharmacopoeal standard, Commercial value, Formulations

Course Details

1. *Ocimum sanctum* (tulsi)
2. *Azadirachata indica* (Neem)
3. *Justicia adhatoda* (Asuro)
4. *Aconitum spicatum* (bikh)
5. *Rauvolfia serpentina* (sarpagandha)
6. *Acorus calamus* (bojho)
7. *Terminalia chebula* (Harro)
8. *Terminalia bellirica* (Barro)
9. *Phyllanthus emblica* (Amala)
10. *Asparagus racemosus* (kurilo)
11. *Swertia chirayita* (chirayito)
12. *Rubia manjith* (majitho)
13. *Oroxylum indicum* (tatelo)
14. *Camellia sinensis* (Green tea)
15. *Lentinus edodus* (shiitake)
16. *Urtica dioica* (Sisno)
17. *Crataeva nurvala* (siplican)
18. *Bauhinia variegata* (Koiralo)
19. *Picrorhiza scrophulariflora* (Kutki)
20. *Rheum australe* (Padamchal)
21. *Momordica charantia* (Tita karala)
22. *Ganoderma lucidum* (rato chayau DXN)
23. *Juglans regia* (okhar)
24. *Dactylorhiza hatagirea* (panch aunle)
25. *Centella asiatica* (ghod taprae)
26. *Cassia fistula* (rajbriksha)
27. *Cannabis sativa* (Ganga)
28. *Allo vera* (Ghu kumari)
29. *Codycep sinensis* (yarsagumba)
30. *Jingiber officinale* (Aduwa)

Reference:

1. Kamal K. Joshi and Sanu D Joshi: *Genetic Heritage of Medicinal and Aromatic Plants of Nepal Himalayas 2001*, Buddha Academic Publishers and Distributors, Kathmandu.
2. W. C. Evans: *Trease and Evans Pharmacognosy* (15th Ed.) 2002, W. B. Saunders, Edinburgh.
3. Indian Pharmacopoeia
4. Japanese Pharmacopoeia
5. Chinese Pharmacopoeia

LAB-14 (Credit hour 1)

**Pharmaceutical Laboratory-14
(Pharmacology)**

B. Pharm., Third Year, Sixth Semester

Course Objectives: *The students will become familiar with the basic pharmacological experiments of in vitro and in vivo conditions.*

Course Content

1. Basic physiological tests and preclinical pharmacological testing (*in vitro*)
2. Clinical pharmacological testing in (animal model – *in vivo*)
3. Local and systemic anesthetics
4. Opioid and nonopioid analgesics
5. Diuretics and antidiuretics
6. Blood glucose level determination in mice model – Antidiabetics

LAB-15 (Credit hour 1)

**Pharmaceutical Laboratory-15
(Quality Assurance)**

B. Pharm., Third Year, Sixth Semester

Course Objectives: *Student will learn simple preparation and pharmacopoeial standard of some pharmaceutical products.*

Course Content

1. Identification
2. Purity testing
3. Drug content determination
4. Instrumental analysis in quality control
 - a) HPLC
 - b) Spectrophotometry
 - c) Thin layer chromatography

Reference Books:

1. Japanese Pharmacopoeia XIII
2. Indian Pharmacopoeia (1996)

LAB-16 (Credit hour 1)

**Pharmaceutical Laboratory 16
(Medicinal Chemistry of Plants)**

B. Pharm., Third Year, Sixth Semester

Course Objectives: *Student will learn the principles of active ingredient isolation from plant material*

Course Content

1. L-ascorbic acid content in three medicinal plants
2. Isolation of Caffeine
3. Cardiac glycosides isolation
4. Glycirizin isolation

SEM-5 (Credit hour 1)

Pharmaceutical Seminar-5

B. Pharm., Third Year, Sixth Semester

Fourth Year

Seventh Semester

FOURTH YEAR

SEVENTH SEMESTER

Code	Description	Credit hours	Pre-requisite course	Core Course
PHT 401	Pharmaceutics X (Cosmetology)	3	PHT 301	☼
PHT 402	Pharmaceutics XI (Clinical Pharmacy)	3	PHT 304	☼
PHL 411	Pharmacology III (Therapeutics and Toxicology)	3	PHL 312	☼
PHC 471	Medicinal Chemistry II (Synthetic Drugs)	3	PHC 373	☼
PHG 481	Pharmacognosy VI (Traditional Systems of Medicine)	3	-----	☼
RES 491	Pharmaceutical Research	3	-----	-----
LAB-17	Pharmaceutical Laboratory 17	1	-----	-----
LAB-18	Pharmaceutical Laboratory 18	1	-----	-----
LAB-19	Pharmaceutical Laboratory 19	1	-----	-----
SEM 6	Pharmaceutical Seminar-6	1	-----	-----
TOTAL		22		

PHT 401 (Credit hours 3)**Pharmaceutics X
(Cosmetology)**

B. Pharm., Fourth Year, Seventh Semester

Course Objectives:

This course will provide students with the knowledge on cosmetic sciences and manufacturing of cosmetic products, as well as necessary safety and quality assurance requirements.

Unit	Course Description	Hrs.
1	History of Cosmetics and Principles of Cosmetology General cosmetology, Decorative cosmetology, Medicinal cosmetology	3
2	Anatomical and Physiological Bases for Cosmetics Skin, Pigmentation, Anomalies, Types of skin, Skin ageing, Percutaneous absorption of cosmetic products, Hair, Anomalies in growth, Nail, Tooth, Sense of smell	8
3	Substances Used in Cosmetic Products Natural substances, Semi-synthetic substances, Synthetic substances, Surfactants, Emollients, Hydrocolloids, Preservatives, Antioxidants, Colors, UV-filters, Packaging material	6
4	Cleansing products Soaps, Baths, Shower gels, Shampoos, Products for intimate hygiene, Products for skin cleansing, Oral dental care products	6
5	Protective Cosmetics Skin-care products, Lip-care products, Hand-care products, Foot-care products, Hair-care products, Tooth-care products, Child-care products, Man's cosmetics, UV filters in skin protection, Sun screen factors, Insect repellents	8
6	Decorative Cosmetics Foundations, Decorative powders, Make up products, Eye cosmetics, Hair cosmetics, Nail cosmetics, Depilators	5
7	Scents Classification, Characteristics, Packaging	3
8	Adverse Reactions to Cosmetics and Cosmetics Regulations Hypoallergenic products, Legal distinction between cosmetics and drugs	3
9	Medicinal Cosmetology Cosmeceuticals	3

Reference Books:

1. Tsuneo Mitsui: *New Cosmetic Science*, 1997, Elsevier, Amsterdam.
2. Peter Elsner and Howard I. Maibach: *Cosmeceuticals, Drugs vs Cosmetics*, 2000, Marcel Dekker, New York.
3. Vijay Malik: *Drugs and Cosmetic Act (16th Ed.)* 2003, Eastern Book Company, Lucknow.

PHT 402 (Credit hours 3)**Pharmaceutics XI
(Clinical Pharmacy)**

B. Pharm., Fourth Year, Seventh Semester

Course Objectives:

In this course the students will learn the principles of clinical pharmacy, the present situation in the field and the future perspectives of clinical pharmacist.

Unit	Course Description	Hrs.
1	Pharmacist-patient Relationship Taking the medication history, Active listening, Ethics, Special treatments for "stigmatized patients"	4
2	Organization of Clinical Pharmacy Pharmacist-physician-nurse relationship, Pharmacist and therapeutic committee, Patient-focused care, Hospital medication orders	4
3	Rational Dosage Regimens Clinical pharmacokinetics, Therapeutic drug monitoring, Patient drug profile forms, RUD, WHO list of Essential Drugs applied to Nepal, Cost-effectiveness monitoring, Information technology, Perspectives	10
4	Drug interactions Drug-drug interactions, Drug-pharmaceutical ingredients interaction, Admixtures, Drug induced modifications of laboratory test values	8
5	Adverse Drug Reactions Local reactions, Systemic reactions, Drug induced diseases, Reporting of known and newly discovered side effects	8
6	Investigational drugs Clinical trials, Regulations, Conclusions	6
7	Special considerations Cancer patients, Elderly patients, Infants, Pregnant patients, Nursing mothers, AIDS patients, Tuberculosis patients, Leprosy patients	5

Reference Books:

1. Roger Walker and Clive Edwards: *Clinical Pharmacy and Therapeutics*, 2003, Churchill Livingstone, Edinburgh.
2. G. Parthasarathi, Karin Nyfort-Hansen and Milan C Nahata: *A Textbook of Clinical Pharmacy Practice*, 2004, Orient Longan, Chennai.
3. Alfonso R. Gennaro: *Remington: The Science and Practice of Pharmacy*, Volume II (20th Ed.) 2002, Lippincott Williams & Wilkins, Philadelphia.
4. A. J. Winfield and R. M. E. Richards: *Pharmaceutical Practice* (2nd Ed.) 1998, Churchill Livingstone, Edinburgh.

PHL 411 (Credit hours 3)

Pharmacology III
(Therapeutics and Toxicology)
B. Pharm., Fourth Year, Seventh Semester

Course Objectives:

The emphasis of this course is to teach the principles of drug-related toxicity, toxic agents and environmental toxicology and regulations on risk assessment.

Unit	Course Description	Hrs	Details
1	General Principles of Toxicology History, Principles of toxicology, Mechanism of toxicity, Risk assessment	4	History, types of poison, types of toxicologist risk assessment and risk management
2	Disposition of Toxicants Absorption, distribution and excretion of toxicants, Biotransformation of xenobiotics, Toxicokinetics	6	route of biotransformation
3	Nonorgan-directed Toxicity Chemical carcinogenesis, Genetic toxicology, Developmental toxicology	4	Genotoxic and non-genotoxic carcinogens and mechanism, introduction, toxicants, symptoms, sources, manifestations.
4	Target Organ Toxicity Toxic responses to blood, Toxic responses to immune system, Toxic responses to liver, Toxic responses to kidney, Toxic responses to respiratory system, Toxic responses to nervous system, Toxic responses to heart and vascular system, Toxic responses to skin, Toxic responses to reproductive system, Toxic responses to eye, Toxic responses to endocrine system	10	Introduction, toxicants and sources, mechanism of toxication, manifestations (if any)
5	Toxic Agents Toxic effects of pesticides, Toxic effects of metals, Toxic effects of solvents and vapors, Toxic effects of radiation and radioactive materials, Toxic effects of animal toxins, Toxic effects of plants	8	Introduction, toxic agents, routes of exposure symptoms, manifestations, treatments and mechanism of toxicity.
6	Environmental Toxicology Air pollution, Aquatic and terrestrial ecotoxicology	5	Introduction, source of pollutants, agents, outcomes
7	Applications of Toxicology Food toxicology, Forensic toxicology, Clinical toxicology, Occupational toxicology, Regulatory toxicology	8	In each-Introduction, sources, agents, applications and importance

Consulting book-Casaxtt & Doull's Toxicology

Reference Books:

1. Curtis D. Klaassen: *Casarett and Doull's Toxicology, The Basic Science of Poisons* (5th Ed.) 1996, McGraw Hill, New York.
2. New York.
3. Melanie Johns Cupp: *Toxicology and Clinical Pharmacology of Herbal Products*, 2000, Humana Press, New Jersey.
4. Alkalank Kumar Jain: *Drugs and Cosmetics* (7th Ed.) 2004, Alkalank Publications, New Delhi.
5. C. K. Parikh: *Parikh's Textbook of Medical Jurisprudence, Forensic Medicine and Toxicology* (6th Ed.) 1999, CBC Publishers, New Delhi.

PHC 471 (Credit hours 3)**Medicinal Chemistry II
(Synthetic Drugs)****Course Objectives:**

In this course the students will learn the principles of medicinal chemistry, properties of drugs affecting their biological action and therapeutic application for drugs of synthetic origin. (II)

Unit	Course Description	Hrs.
1	Synthetic Drugs Classification of synthetic drugs, drug design and recent approaches to the synthesis of drugs	2
2	Chemistry, Biological Action and Therapeutic Application of the following: Analgesics and Antipyretics Morphine derivatives, Antitussive agents, Anti-inflammatory analgesics, Antipyretics	2
3	Local and General Anesthetics Mechanism of action, Administration, Factors affecting effectiveness, Rate of onset and duration of anesthesia, Secondary pharmacological action, Structure-action relationship	3
4	Sulfonamides, Sulfons and Folate Reductase Inhibitors with Antibacterial Action Sulfonamides and folate reductase inhibitors, Well-absorbed, Short- and Intermediate-acting sulfonamides, Sulfonamides for ophthalmic infections, Sulfonamides for burn therapy, Sulfonamides for intestinal infections, ulcerative colitis or reduction of bowel flora, Sulfones	3
5	Anti-infective Agents, Antibiotics and Antiviral Agents Local anti-infective agents, Alcohols and related compounds, Phenols and their derivatives, Oxidizing agents, Halogen-containing compounds, Chlorine-containing compounds, Cationic surfactants, Dyes, Mercury compounds, Preservatives, Antifungal agents and antibacterial agents, Antibiotics-overview, β -lactam antibiotics, Aminoglycosides, Tetracyclines, Macrolides, Lincomycins, Polypeptides, Antitubercular drugs, Antiprotozoal drugs, Anthelmintics, Antiscabious and antipedicular agents, Antiviral agents	8
6	Antimalarials Modern malarial therapy, Malaria vaccine, Synthetic antimalarial drugs	2
7	Antihistamines Histamine H1-receptor antagonists, Inhibition of histamine release, Histamine H2-receptor antagonists, Histamine H3- receptor ligands	3
8	Antineoplastic agents Tumor cell properties, Alkylating agents, Antimetabolites, Antibiotics, Hormones, Immunotherapy, Future antineoplastic drugs	3
9	Diuretics Site 1 diuretics-carbonic anhydrase inhibitors, Site 3 diuretics-thiazide and	3

	thiazide-like diuretics, Site-2 diuretics-highceiling or loop diuretics, Site 4 diuretics-potassium-sparing diuretics, Miscellaneous diuretics	
10	Cardiovasuclar Agents of Synthetic Origin Antianginal agents and vasodilatators, Antiarrhythmic drugs, Antihypertensive drugs, Antihyperlipidemic agents, Anticoagulants, Hypoglycemic agents, Thyroid hormones antithyroid drugs	3
11	CNS Depressants and CNS Stimulants Mechanism of action, Anxiolytics, Sedative and hypnotic agents, CNS depressant with skeletal muscle relaxant properties, Antipsychotic, Anticonvulsant or Antiepileptic drugs, Analeptics, Methylxanthines, Central sympathomimetic agents, Monamine oxidase inhibitors, Trucyclic antidepressant compounds, Psychedelics	4
12	Adrenergic agents and cholinergic drugs Drugs affecting adrenergic neurotransmitters, Symphatomimetic agents, Adrenergic receptor antagonists, Cholinergic agonists, Cholinergic receptor antagonists, Cholinergic blocking agents, Parasympathetic postganglione blocking agents, Ganglionic blocking agents, neuromuscular blocking agents	4
13	Prodrugs Basic concepts, Prodrugs of functional groups, Bioprecursor prodrugs, Chemical Delivery Systems	2
14	Biotechnology and Drug Discovery Cloning DNA, New biological targets for drug development, Novel drug-screening techniques, Novel biological agents, Antibodies, Antisense oligonucleotide therapy, Gene therapy, Products	3

Reference Books:

1. Jaime N. Delgado and William A. Remers: *Wilson and Gisvold's Textbook of Organic Medicinal and*
2. *Pharmaceutical Chemistry* (10th Ed.) 1998, Lippincott-Raven Publishers, Philadelphia.
3. William O. Foye, Thomas L. Lemke and David A Williams: *Principles of Medicinal Chemistry* (4th Ed.) 1995,
4. Lippincott Williams and Wilkins, Philadelphia.
5. Gorg Walsh: *Biopharmaceuticals, Biochemicals and Biotechnology* (2nd Ed.) 2003, John Wiley and Sons,
6. Chichester.

PHG 481 (Credit hours 3)

Pharmacognosy VI
(Traditional System of Medicine)
 B. Pharm., Fourth Year, Seventh Semester

Course Objectives:

This course will provide students with knowledge on traditional systems of medicine practiced in Asia.

Unit	Course Description	Hrs.
1	Traditional Systems of Medicine: Concept and Overview Historical background, Concepts, Evidence of efficacy, Quality control, Legal aspects, Safety, Concept and Traditional and alternative system	4
2	Ayurveda Evolution of Ayurveda, Natural philosophy, Bioregulating principles: Tridosha, The interior of the body and the digestive processes, Understanding tastes: Rasas, Pathology in Ayurveda, Diagnostic methodology in Ayurveda: Nidana, General principles of treatment: Chikitsa, The Panchakarma therapy, Pharmaceutical preparations used in Ayurveda therapy, Rasashastra, Nadivigyana, Nadi, Prana, Healthy living according to Ayurveda, Globalization of Ayurveda	18
3	Tibetan Traditional Medicine Tibetan medical philosophy, Disease, Diagnosis, Treatment, Common Tibetan prescriptions, Behavioral therapy	6
4	Chinese Traditional Medicine Origins and development, Tao and Yin-Yang philosophy, Five elements, Essential substances, Organs, Meridian system, Disease cuasation, Diagnosis and Differentiation, Therapeutic modalities and ideas, Chinese herbal drugs	6
5	Kampo Medicine Concept, Stages of disease, Clinical examination, Diagnosis, Kampo prescriptions	3
6	Homeopathy and Aromatherapy Origins, Prescribing, Dispensing, Materia Medica, In practice, Aromatherapy, Applications, Essential oils	4
7	Nepalese Healing Traditions Traditional tribal healers, Ethnic specificity, Classification, Recording and future	4

Reference Books:

1. Ashok Majumdox: Ayurveda, *The Ancient Indian Science of Healing*, 1988, Wheeler Publishing, New Delhi.
2. M. Abdul Kareem: *Plants in Ayurveda*, 1997, Foundation for Revitalization of Local Healing Traditions, Bangalore.
3. Tom Dummer: *Tibetan Medicine and other holistic health-care systems*, 1998, Paljor Publications, New Delhi.
4. Robert Svoboda and Arnie Lade: *Tao and Dharma, Chinese Medicine and Ayurveda*, 1995, Lotus Press, Twin Lakes.
5. Tapan C. Mondal: *Textbook of Homoeopathic Materia Medica*, 2000, Books and Allied Ltd., Calcutta.
6. *Medicinal Plants of Nepal*, 1997, Bulletin of the Department of Medicinal Plants, No. 3, His Majesty's Govt. of Nepal, Ministry of Forests and Soil Conservation, Department of Plant Resources, Kathmandu.
7. Kamal K. Joshi and Sanu D. Joshi: *Genetic Heritage of Medicinal and Aromatic Plants of Nepal Himalayas*, 2001, Buddha Academic Publishers and Distributors, Kathmandu.

RES 491 (Credit hours 3)**Pharmaceutical Research**
B. Pharm., Fourth Year, Seventh Semester**Course Objectives:**

The course will enable students to independently search the relevant pharmaceutical literature, and write a research project based on scientific background. The research project will be submitted to relevant authorities.

Unit	Course Description	Hrs.
1	Medline and Related Data Bases 7 hours Introduction to literature search, Key words, Medline, PubMed, SCI, Current Contents, Chemical Abstracts, Biological Abstracts,	7
2	Pharmaceutical and Pharmacy-related Publications The most quoted journals, Original research article, Review article, Short communication, Notes, Rapid communication, Conferences, congresses and symposiums, Workshops	7
3	Research Article Summary, Key words, Introduction, Materials and methods, Results, Discussion, Conclusions, References	
4	Patents Patent, Access to patents, Citation of a patent, Expired patents	3
5	Writing a Research Proposal* Literature search, Originality, Applicability to the available resources, Time-frame, Report, Publications * Four students are jointly writing a proposal under the supervision of a teacher. The proposal will be submitted to the relevant authorities.	23

LAB-17 (Credit hour 1)

Pharmaceutical Laboratory-17 (Cosmetology)

B. Pharm., Fourth Year, Seventh Semester

Course Objectives: *The students will manufacture cosmetic products ex temporaneously and characterize them.*

Course Contents:

- | | |
|--|---|
| 1. Cleansing and protective skin creams | 2. pH-determination and emulsion type determination |
| 3. Lotions | 4. Stability testing of lotions and ointments |
| 5. Decorative powders | 6. Hair cosmetics: gel and shampoo |
| 7. Deodorants and liquid hand soaps | 8. Tooth paste and mouth wash |
| 9. Cosmetics based on natural origin ingredients | 10. Nail cosmetics |

Reference Books:

1. Tsuneo Mitsui: *New Cosmetic Science*, 1997, Elsevier, Amsterdam.

LAB-18 (Credit hour 1)

Pharmaceutical Laboratory-18 (Toxicology)

B. Pharm., Fourth Year, Seventh Semester

Course Objectives: *Introduction to basic toxicological practice in in vitro and in vivo conditions*

Course Contents:

Estimation of arsenic in tap water, carbon monoxide in air, LD50 of some commonly used drugs, carcinogenic properties of certain PCs, , toxic effect of dioxane and case study of poisonous deathand toxicological evidence of pharmaceutical products through local hospital.

LAB-19 (Credit hour 1)

Pharmaceutical Laboratory-19 (Traditional Systems of Medicine: Formulations)

B. Pharm., Fourth Year, Seventh Semester

Course Objectives: *Students will become familiar with Ayurvedic, Unani and Tibetan medicinal formulations and specificity of their preparations (some examples are given below)*

- | | |
|----------------------|-------------------------|
| 1. SHARBAT NARANJ | 2. ROGHAN BAIZA-I-MURGH |
| 3. SUFUF BARQ | 4. SITOPALADI CHURNA |
| 5. TRIPHALA CHURNA | 6. HAB PAPE ETA |
| 7. ITRIFAL KISHMISHI | 8. VASAVALEHA |

Reference Books:

1. Hakim Mohammad Said: *Hamdard Pharmacopoeia of Eastern Medicines* (2nd Ed.) 1997 Sri Satguru Publications, Delhi.
2. Chandra Raj Sapkota (2000) *Ayurveda Medicine Production Science*, NPTC, Kathmandu

SEM-6 (Credit hour 1)

Pharmaceutical Seminar-6

B. Pharm., Fourth Year, Seventh Semester

Fourth Year

Eighth Semester

EIGHTH SEMESTER

Code	Description	Credit hours	Pre-requisite course	Core Course
PHT 403	Social Pharmacy and Pharmaceutical Jurisprudence	3	PHT 402	☼
PHT 404	Pharmacoeconomics and Management	3	-----	☼
PHT 405	Pharmacy Practice	3	-----	-----
PRW 491	Project Work	6	-----	-----
TOTAL		15		

PHT 403 (Credit hours 3)

Social Pharmacy and Pharmaceutical Jurisprudence

B. Pharm., Fourth Year, Eighth Semester

Course Objectives:

The students will become familiar with the role of social pharmacy, pharmaceutical jurisprudence and regulatory requirements regarding social pharmacy in Nepal.

Course Contents:

1. Health and Disease 6 hours

Towards health for all, Role of WHO, Preventive medicine, Environment and health, Occupational health, Health information, Communication for health education, Health planning, International health

2. Pharmacy in Society 12 hours

Role of community pharmacy, Role of pharmacist, The contribution of pharmacy to today's health care provision, Social and behavioral aspects of pharmacy, Role of pharmacist in allopathic and traditional medicine treatments

3. Medical Jurisprudence 6 hours

Legal procedure in criminal courts, History of forensic medicine, Overview

4. Pharmaceutical Jurisprudence 16 hours

Ethics and professionalism, Pharmacy Acts, Drug regulations, National Drug Policy, Poisons and their regulations, Narcotics, Radiopharmaceuticals, WHO agreement, Consumer Act, Consequences of misuse

5. Regulatory Requirements for Social Pharmacy 5 hours

Acts, Space requirements, Regulations, Associations, Present situation in Nepal

Reference Books:

1. K. Park: *Park's Textbook of Preventive and Social Medicine* (16th Ed.) 2000, Banarsidas Bhanot Publishers, Jabalpur.
2. B. V. Subrahmanyam: *Modi's Medical Jurisprudence and Toxicology* (22nd Ed.) 1999, Butterworths, New Delhi.
3. Alfonso R. Gennaro: *Remington: The Science and Practice of Pharmacy*, Volume II (20th Ed.) 2002, Lippincott Williams & Wilkins, Philadelphia.
4. A. J. Winfield and R. M. E. Richards: *Pharmaceutical Practice* (2nd Ed.) 1998, Churchill Livingstone, Edinburgh.
5. Leon Shargel, Alan H. Mutnick, Paul F. Souney and Larry N. Swanson: *Comprehensive Pharmacy Review* (5th Ed.) 2004, Lippincott Williams & Wilkins, Philadelphia.

PHT 404 (Credit hours 3)

Pharmacoeconomics and Management

B. Pharm., Fourth Year, Eighth Semester

Course Objectives:

In this course the students will learn the principles of pharmacoeconomics and management principles related to drugs and pharmaceutical practice.

Course Contents:

1. Pharmaco-economics

8 hours

Fundamentals, Principles, Cost-calculations, break-even analysis and cost effectiveness analysis, Time value of money, Discounting and depreciation analysis, Financial analysis, Taxation and alternative health care financing (drug scheme) in Nepal

2. Management

10 hours

Fundamentals, Principles, Management and administration, Role of a manager, Functions of management, Production management, Entrepreneurship management, Managing small businesses, Role and impact of business in Nepalese economy

3. Community Pharmacy Economic and Management

6 hours

Economics of health care, Community pharmacy organization, Site selection, Capital, Management, Objectives and goals, Money, Inventory, Facilities, Personnel, Credit, Risk

4. Documenting and Billing for Pharmaceutical Care Services

6 hours

The role of documentation in pharmaceutical care, Narrative documentation, Standardizes documentation system, Limitations of standards, General payment principles, Records: legal, patient, financial

5. Product Recalls and Withdrawals

3 hours

Recall procedures, Background information on recalls, Consequences

6. Marketing Pharmaceutical Care Services

12 hours

Fundamentals of marketing, Marketing plan, SWOT analysis, Target markets and stakeholders, Marketing mix, Features versus benefits of the product or service, The marketing cycle, Promotion, advertising and sales management, Medical representatives, Customers services

Reference Books:

1. Alfonso R. Gennaro: *Remington: the Science and Practice of Pharmacy*, Volume II, 20th Edition, Lippincott Williams & Wilkins, Philadelphia, 2002.
2. Mickey Smith (Ed.): *Principles of Pharmaceutical Marketing* (3rd Ed.) 2002, CBS Publishers and Distributors, New Delhi.
3. Ashok K. Gupta: *Handbook of Drug Store and Business Management*, 2003, CBS Publishers and Distributors, New Delhi.
4. Leon Shargel, Alan H. Mutnick, Paul F. Souney and Larry N. Swanson: *Comprehensive Pharmacy Review* (5th Ed.) 2004, Lippincott Williams & Wilkins, Philadelphia.

PHT 405 (Credit hours 3)

Pharmacy Practice

B. Pharm., Fourth Year, Eighth Semester

Course Objectives:

The students will become familiar with the role of pharmacist in pharmacy practice, dispensing techniques and development of physician-patient-pharmacist relationship.

Course Contents:

1. Communication Skills for Pharmacist 4 hours

Meaning and types of communication, Assumptions and expectations in communication, Questioning and listening skills, Communicating with those with special needs, Non-verbal communication, Assertiveness, Transactional analysis, Barriers to communication

2. Prescription 3 hours

The structure and abbreviations used on a prescription, Generic prescribing, "Repeat" prescribing and dispensing, Procedures for checking the prescription, Record keeping, Preventing errors during dispensing

3. Basic Principles of Compounding and Dispensing 12 hours

Types of dosage forms, Weights, measures and units, Calculations for compounding and dispensing, Fundamental operations in compounding, GMP in compounding and dispensing, Formulation of dispensed products, Storage and stability of dispensed products, Containers and closures for dispensed products, Responding to the prescription, Labelling of dispensed medicines, Product recalls and withdrawals

4. Pharmaceutical Preparations 6 hours

Solutions, Suspensions, Emulsions and creams, Ointments, pastes and gels, Suppositories, Powders and granules, Oral unit dosage forms, Therapeutic aerosols, Wound management, stoma and incontinence patients, Medical gases

5. Sterile Pharmaceutical Preparations 4 hours

Aseptic technique, Design and operation of clean rooms, Parenteral products, Intravenous additives, Dispensing of cytotoxic agents, Total parenteral nutrition, Ophthalmic products, Principles of quality assurance, Sterility testing

6. Relating to the Patient 6 hours

Patient compliance and counseling, Patient medication records, Responding to symptoms, Diagnostic tests, Substance misuse, Addictions

7. Relating to the Prescriber**6 hours**

Therapeutics in practice, Practical pharmacokinetics, Therapeutic drug monitoring, Adverse drug reactions, Drug information and pharmaceutical advice

8. Additional Information**4 hours**

Medical abbreviations, Latin terms and abbreviations, Qualifications of practitioners, System of weights and measures, Sources of information for compounding and dispensing, Homeopathic medicine and traditional medicine preparations

Reference Books:

1. Dianne M. Collett and Michel E. Aulton: *Pharmaceutical Practice*, Churchill Livingstone, Edinburgh, 1996.
2. A. J. Winfield and R. M. E. Richards: *Pharmaceutical Practice*, 2nd Edition, Churchill Livingstone, Edinburgh, 1998.
3. Alfonso R. Gennaro: *Remington: the Science and Practice of Pharmacy*, Volume II, 20th Edition, Lippincott Williams & Wilkins, Philadelphia, 2002.
4. S. J. Carter (Ed.): *Cooper and Gunn's Dispensing for Pharmaceutical Students* (12th Ed.) 2000, CBS Publishers and Distributors, New Delhi.
5. Leon Shargel, Alan H. Mutnick, Paul F. Souney and Larry N. Swanson: *Comprehensive Pharmacy Review* (5th Ed.) 2004, Lippincott Williams & Wilkins, Philadelphia.

PRW 491 (Credit hours 6)

Project Work

B. Pharm., Fourth Year, Eighth Semester

Course Objectives:

The final project work will enable the students to search the relevant scientific literature, plan and perform original scientific work and write the thesis according to the world-recognized scientific standards. In the cases of successful projects of international relevance, the students will submit original research communications and articles to the recognized scientific journals.

IMPORTANT NOTICE TO STUDENT

Don't Miss!

- To attend daily lecture. If your attendance is less than 80%, you will not be allowed to sit in the final examination of University
- To secure more than 50% marks in average (D grade) of two internal assessments in a particular subject otherwise you will not be allowed to take part in the final examination of the University
- To secure D grade in final examination to pass the particular subject
- To secure SGPA 2.0 (C Grade) otherwise you will not enrolled to next semester.

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