HEMCHNDRACHARYA NORTH GUJARAT UNIVERSITY
PATAN - 384 265

NAAC Accreditation Grade - " B " | ISO 9001 - 2008 Certified

Bachelor of Vocation Programme

Pharmaceutical Chemistry

Syllabus / Scheme

SEMESTER - I

WITH SEMESTER/ CBCS/ GRADING PATTERN

W. E. F. : June - 2014

DATE : 31 – 07 - 2014

TOTAL PAGE – 21

Preface

The University Grants Commission (UGC) has launched a scheme on skills development based higher education as part of college/university education, leading to setting up of Bachelor of Vocation courses (B.Voc.) to serve multiple needs, including (i) career oriented education and skills to students interested in directly entering the workforce; (ii) contracted training and education programmes for local employers; (iii) high-touch remedial education for secondary school graduates not ready to enroll in traditional colleges, giving them a path to transfer to three or four year institutions; and (iv) general interest courses to the community for personal development and interest. Bachelor of Vocation will have with multiple exits such as Diploma and Advanced Diploma under the NSQF (National Skills Qualifications Framework).

The Bachelor of Vocation model, by and large, will be accessible to a large number of individuals of the community, offer low cost and high quality education locally, that encompasses both vocational skills development as well as traditional coursework, thereby providing opportunities to the learners to move directly to the employment sector or move into the higher education sector. It offers a flexible and open education system which also caters to community-based life-long learning needs.

About the programme

The program is designed to educate and create skilled manpower that can serve the society through the knowledge gained during the course of time. The student enrolling in the course will be benefitted in several ways. The candidate will work in the college as well as with the industries during the time of his study. If a candidate successfully completes first year of study he would be awarded a diploma and he will be capable enough to serve as a laboratory assistant in any industry or academic institution. A candidate completing two successful years in Bachelor of Vocation program will be awarded with advanced diploma. An advanced diploma qualified student in Pharmaceutical Chemistry will be fit for working in ADL, QC and Production department of any pharmaceutical industries. The candidate completing all three years of the course successfully will be awarded with Bachelor of Vocation in Pharmaceutical Chemistry and is fit for getting absorbed in any division of Pharmaceutical Industries.

Semester I

Course Code	Course Title	Credit		Total
		Theory	Practical	
PC 111	Basic Pharmaceutical Calculations	3	0	3
PC 112	Pharmaceutics (Basic Principles)	3	0	3
PC 113	Basic Computer Applications	0	2	2
PC 114	English and Communication Skill	0	2	2
PC 115	Human Anatomy and Physiology	2	0	2
PC 116	Practicals	0	18	18
Total		**08**	**22**	**30**

BVPCR1: Eligibility Criteria (EC) for Admission

1. The eligibility conditions for admission to the program will be 10+2 or equivalent in science stream or diploma chemical or diploma pharmacy
2. If the candidate has attained the specific level 4 of NOS of pharmaceutical chemistry sector (by decision of equivalence committee of the college) can get admitted in B.Voc. for the programme
3. There is no age bar for admission to Bachelor of Vocation
4. The student can take exit from this course at any point of time and can get re-entry in this programme. Such students will get priority in admission than to a fresher student. (multi entry multi exit scheme)

BVPCR2: Admission Procedure

1. For admission to the programmes offered, preference should be given to the learners living in the local community. Reservation to SC, ST, OBC and PwD categories will be available as per the extant national / State policy.
2. Admissions may be done on a rolling basis depending on the duration of the programmes to facilitate a steady stream of learners joining the college and moving out as trained work force to the job market, round the year and not just once in a year.
3. The applicants seeking re-entry into the college should get preference in admission over the new applicants.
4. Candidates are selected on the basis of Merit.

BVPCR3: Fees and Scholarship:

1. Student fee should be decided as per the prevalent practice for fee fixation for aided courses.
2. Attempt should be made to recover part of the operating expenditure from the student fees.

BVPCR4: Registration / Enrollment:

1. Every student admitted to the college for the programme must get enrolled to university within a month from the date of admission.

4 05

BVPCR5: Semester Examinations

1. Candidates desirous of appearing at any Semester Examination shall have to submit applications in the prescribed form, through the designated authority on or before the prescribed date.
2. No candidate will be admitted to any Semester examination unless the Designated Authority i.e. the Head of the Department or Principal of the College certifies that:
   (1) The candidate attended the course of study to the satisfaction of the designated authority.
   (2) The candidate maintained a good conduct and character during the studies.
   (3) The candidate maintained minimum 80% attendance in each semester

BVPCR6: Evaluation

1. Appropriate mechanism for assessment of the learners' progress towards acquisition of knowledge and skill should be developed by the College. Partner industries should also be given a clear and well defined role in the assessment of the learners.
2. Practical or hands on skills should be given comparatively more weightage in the overall assessment plan.
3. The College should adopt and integrate the guidelines and recommendations of the respective Sector Skill Councils (SSCs) for the assessment and evaluation of the vocational component, wherever available. They should also involve the SSCs in the assessment process, wherever required. It applies to colleges, both Autonomous and non-Autonomous, and universities to maintain Occupational Standards and the fitness for the job.
4. Theory of each CORE paper will be evaluated for a maximum of 100 marks out of which, 50 marks-shall be for Continuous evaluation (Exams) and 50 marks for the end semester examination. An end semester examination shall be of 2 hours duration.
5. Practical as a combined form for Each core paper will be evaluated for a maximum of 700 marks out of which, 500 marks shall be continuous internal evaluation and 200 marks for the end semester practical examination.

6. Each Elective paper is evaluated for a maximum of 50 marks which will be evaluated internally by continuous evaluation.

BVPCR7: rules for grading

1. One Credit would mean equivalent of 14-15 periods of 60 minutes each, for theory, workshops / labs and tutorials per semester.
2. For internship / field work, the credit weightage for equivalent hours shall be 50% of that for lectures / workshops
3. For self-learning, based on e-content or otherwise, the credit weightage for equivalent hours of study shall be 50% of that for lectures / workshops
4. To pass a subject in any Semester a candidate must obtain a minimum of 40% of marks in each paper.
5. If a candidate fails in any subject, he has to reappear for that particular paper and pass. (That is, for example if candidate fails in midterm exam of a subject, he has to reappear for midterm of that subject.)
6. The performance of each candidate in all the subjects will be evaluated on 7- point scale in term of grades as follow:

Grading Scheme		%age according to Grade	Grade Points	Qualitative Meaning of Grade
1	A +	90-100	10.0	Outstanding
2	A	80-89	9.0	Excellent
3	A-	70-79	8.0	Very Good
4	B +	60 – 69	7.0	Good
5	B	50-59	6.0	Average
6	B-	40-49	5.0	Fair
7	F	Less Than 40	0	Fail
8	I	Incomplete		

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BVPCR8: performance index

1. The performance of a student in a semester is expressed in terms of the **Semester Performance Index (SPI).**

   SEMESTER PERFORMANCE INDEX (SPI)

   The Semester Performance Index (SPI) is the weighted average of Course Grade Points obtained by the student in the semester. The Weights assigned to Course Grade Points are the Credits carried by the respective courses.

   $$SPI = \frac{g1\,c1 + g2\,c2 + \ldots}{c1 + c2 + \ldots\ldots}$$

   Where, g 1 , g 2 ..... are the Grade points obtained by the student in the Semester, for Courses carrying Credits c 1 , c 2 .....respectively.

2. The cumulative performance of a student at the end of the Semester / Course is expressed in terms of the **Cumulative Performance Index (CPI).**

   CUMULATIVE PERFOMANCE INDEX (CPI)

   This index is defined as the weighted average of Course Grade Points obtained for all the weights for Theory Papers (Both Mid Term & End Term) and Practicals attempted since his admission to the program, where the weights are defined in the same way as in **Semester Performance Index (SPI).**

3. If a failed student repeats a course, only the Grade Points obtained in the latest attempt shall be counted in the **Cumulative Performance Index.** Whenever the candidate clears the subject in the next semester examination, the total credits for that subject will be added to CPI.

4. For any Semester, the maximum marks for the Mid Term and End Term assessments are shown in the teaching and examination scheme. For the purpose of Mid Term assessment, tests, quizzes, assignments or any other suitable methods of assessment may be used by the department.

BVPCR9: semester passing scheme

1. For each semester examination, a candidate will be considered as pass if he/she has secured "B-" or above grade in all the subject (s) and overall grade point 5.00 or above.

2. For each semester examination, a candidate will be considered as fail if he/she has secured "F" grade in any or all the subject (s).
3. If the candidate does not fulfill the subject requirements including requisite attendance percentage, he/she will be given I grade and the candidate will have to complete the course requirements before the commencement of the next End Semester examination. If the candidate does not clear I grade in any subject before the commencement of the next End Semester examination, he/she will be considered fail - F grade.
4. Candidate has to clear his / her 'F' grade or 'I' grade, if any, by the next End Semester examination.

BVPCR10: semester promotion scheme

A candidate will be promoted to the subsequent Semester according to the following scheme:

1. A candidate would be granted admission to the Second Semester if and only if he/she has been granted Term for First Semester and has applied for the university examination.
2. A candidate would be granted admission to the Third Semester if and only if he/she has been granted Term for First & Second Semesters and has applied for the university examination.
3. A candidate would be granted admission to the Fourth Semester if and only if he/she has cleared all the subjects of First Semester. He /She will be permitted to pursue his/her study of Fourth Semester, provided his/her term for II & III Semesters is granted and has applied for the university examination.

Promotion Criteria

Semester	Condition(s) For Promotion
II	Grant of Term for Semester – I
III	Grant of Term for Semester I and Semester II
IV	Clearing of Semesters I completely and Grant of Term for Semester II & Semester III

V	Clearing of Semesters II completely and Grant of Term for Semester III & Semester IV

VI	Clearing of Semesters III completely and Grant of Term for Semester IV & Semester V

BVPCR11: award of grading / division

No class/ division will be awarded to the students in the first 5 semesters. Divisions shall be awarded only at the end of Final Examinations on successful completion of all the Semesters. For awarding the degree at the end of the course, Cumulative Performance Index (CPI) of all the Mid Term and Final exams shall be taken in to consideration as per the following pattern of **Cumulative Performance Index (CPI)**:

S.N.	CPI	Division
1	7.50 to 10.00	FIRST Division with Distinction
2	6.50 to 7. 49	FIRST Division
3	6.00 to 6. 49	SECOND Division

BVPCR12: award of degree

1. Award of Certificate, Advanced certificate, Diploma or Advanced Diploma, as the case may be, would depend on acquisition of requisite credits as prescribed by the certification body and not on the duration of the calendar time spent in pursuing the course.
2. The certificate shall mention the credits earned, course duration (in hours), and the curriculum covered. If the course is aligned with NVEQF / NSQF, the corresponding NVEQF / NSQF level should also be mentioned on the certificate.
3. Award of degree will be as follows

NVEQF Level	Skill Component Credits	General Education Credits	Normal calendar duration (post meeting the entry criterion)	Awards
7			Six semesters	Bachelor of Vocation
6	72	48	Four semesters	Advanced Diploma
5	36	24	Two semesters	Diploma
	18	12	One semester	Advanced Certificate
	9	6	Three Months	Certificate

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MODEL PAPER

Hemchandracharya North Gujarat University,Patan
Bachelor of Vocation
'Pharmaceutical Chemistry' Semester - I
END TERM Examination, November, 2014
Subject:

Time: 2 hrs **Date** **Maximum marks: 50**

Q.1 Answer any 9 questions. Each question carries 1 mark (9*1=9 Marks)
(OBJECTIVEQUESTIONS)

1. a) b) c) d)
2. Fill in the blank.
3. Short Questions / Definitions.
4. Match the following.
5. Assertion / Reason of
6. a) b) c) d)
7. Fill in the blank.
8. Short Questions / Definitions.
9. Match the following.
10. Assertion / Reason of True / False.

Q. 2 Answer any 5 questions. Each question carries 4 marks (5*4=20 Marks)
(SHORT QUESTIONS)

1.
2.
3.
4.
5.

Q.3 Answer any 3 question. The question carries 07 marks (3*7=21 Marks)
(DESCRIPTIVE QUESTIONS)

1.
2.
3.
4.

PC-111 Basic Pharmaceutical Calculations

RATIONALE : Lots of calculations are required in pharmaceutical chemistry profession which involves basic mathematics and knowledge of simple physics and chemistry principles. The course is intended to teach the student how such calculations are done. The subject will be fundamental for many of the subjects the student will encounter in future.

COURSE OBJECTIVES :

To make student learn the basic calculations a pharmaceutical chemistry professional is expected to do in his/her professional life.

LEARNING OUT COMES :

The student should be able to :

1) Carry out routine calculations involved in pharmaceutical chemistry profession.
2) Draw and understand different graphs

PREREQUISITES : Basic knowledge of arithmetic, physics and chemistry.

SYLLABUS

Unit-1

a) Rational nos.

Proportional set of nos., Ratios, Fractions, Decimals, Percentage.

b) Other nos.

Exponents and Logarithms, Variables, Constants and Parameters, Graphical presentation of data

.) Slope and Intercept.

Unit-2

a) Systems and units

Mass and weights, Metric units, Conversions between systems, Temperature conversions and others.

b) Ratios, proportions, and percentage

Percent calculations, Prportions, Concentration systems, Part per million, Calculation of amount of ingredients required to make up percentage solutions, Conversion from one to another strength.

Unit-3

a) Dilutions

Simple dilutions, Serial dilutions, concentrated solutions' strengths, multiple dilutions, mixing concentrations.

b) Density

Determination of density, specific gravity

Determination of displacement value, Displacement volumes

Unit-4

a) Molecular weight

Moles, millimoles, milliequivalents, milliosmoles.Molar concentrations.

b) Accuracy and measurements

Rounding nos. Significant figures, Correcting nos, Accuracy in arithmetic calculations, Accuracy in weighing, measuring for assays, Limits and uniformity of content.

Unit-5

a) Parenteral solutions and isotonicity

Rate of flow of IV solutions, Isotonicity

b) Alcohol calculations

Reference books:

1. A. J. Winfield,J. A. Rees, I. Smith, Pharmaceutical Practice, 4th edition, Elsevier publication.
2. Christopher A. L. and D.B. Pharmaceutical compounding and Dispensing, Pharmaceutical press.
3. D.P., G. Dosage Calculations, Delmar Publishers.
4. Don A. B. and T. W. G. Pharmacy Calculations, CBS Publisher.
5. Cooper and Gunn's. Dispensing for Pharmaceutical students, ed. S. J. Carter, 12th edition. CBS Publisher.
6. JudithA. R, IanS, et al. Introduction to Pharmaceutical Calculations, Pharmaceutical Press.

PC-112 Pharmaceutics (Basic Principles)

RATIONALE : The subject is meant for exposing the student to different dosage forms, Routes of drug administration and their merits and demerits. Also the student will be provided knowledge of fundamental physical properties of compounds useful in manufacturing of drug formulations. The in depth understanding of some of the important basic processes used in Industry will also be taught.

COURSE OBJECTIVES :

1. To make student understand the different dosage forms and routes of administration.
2. To understand the important physical properties of compounds and its impact in preparation and stability of drug formulation
3. To understand the common processes used in manufacturing of drug formulations.

LEARNING OUT COMES :

The student should be able to:

1. Narrate various dosage forms, routes of administration and their merits and demerits
2. Describe importance of environmental factors on drug manufacturing.
3. Explain some unit processes used in industry.
4. Describe the importance of certain physical properties of drugs and excipients and their utilization in drug manufacturing.

PREREQUISITES : The student knowledgeable of basic physics and chemistry can take this course well.

SYLLABUS

Unit-1 Introduction

Introduction to Different dosage forms, Routes of administration and their comparisons, Environment control in Pharmaceutical industry and its importance, Importance of air, water, Humidity, Temperature in drug manufacturing giving some examples.

Unit-2

a) Introduction to various processes in Pharmaceutical manufacturing units

Principles of heat transfer: Modes of Heat transfer

Sources of heat—Steam and Electricity

Factors affecting:-Rate of evaporation, Differentiations between Evaporation, Distillation, Rectification, Precipitation, Crystallization.

Brief introduction:- Solvent distillation and its application. Different types of heat reactions—Heats of reactions and formations, Heat of melting, vaporization and sublimation, Differential and integral heat of hydration and salvation.

b) Introduction to dispensed products

Classification of dispensed products: Brief description and applications of each product. Difference between extemporaneous preparations and Non extemporaneous preparations.

Classification as per physical state—Solids, Liquids, Semisolids, Inhalations.

Classification as per route of administration, Classification as Sterile and non-sterile preparations, Classification as Galenicals and non galenicals

Packaging of dispensed products:- Containers and closures. Labeling of dispensed products

Unit-3

a) States of matter

Different states of matter

Hygroscopic

temperature, Liquid crystals, Liquid

Two component system containing solid—Solid liquid phases, Eutectic mixtures

b) Polymorphism

What is Polymorphism, Pseudo polymorphism, Solvates and Hydrates, Metastable forms? Examples of polymorphic drugs and effect on physicochemical properties

c) Principles of fluid flow

Reynolds's no., and its importance. Types of flow

Importance of types of flow in Pharmaceutical processing.

Unit-4

Solubility and solubilisation: Definitions and expressions Physical properties of different solvents and solutes and their effects on solubility, Major pharmaceutical solvents –brief discussions. Liquid systems Partitioning between immiscible solvents and partition co

Effect of pH on solubility—Dissociation constant. Solubilisation techniques –Brief discussion.

Complexation:-Classification of complexes and its applications.

Concept of Filtration and filtration techniques.

Reference books:

1. C.V.S, S. Pharmaceutical engineering , Principles and Practice, Vallabh Prakashan.
2. K., S. Pharmaceutical Engineering New age International publishers.
3. P., M. Elementry chemical engineering, Tta macgrowhill.
4. Physical Pharmacy By Alfred Martin.
5. Physical pharmaceutics, E.Shotton, Indian edition, oxford press.
6. Physico chemical principles of pharmacy, 5thedition,Alexander T. Florence and David Attwood., Pharmaceutical press.

PC-113 Basic Computer Application

RATIONALE : Computers have become essential component in any profession. Basic knowledge of computers for preparing documents, do calculations of data gathered during experiments and also draw graphs is must for any professional.

COURSE OBJECTIVES : To learn proper usage of computers for preparing documents, conduct simple calculations and provide pictorial representation of data.

LEARNING OUT COMES :

The student should be able to:

1) Prepare documents in MS Word
2) Preparing data tables in MS
3) Do calculation in MS of the data collected from various experiments using simple operations and formulas.
4) Draw Graphs in MS

PREREQUISITES : Basic computer operations

SYLLABUS

Unit-1

Computer Fundamentals: MS

Unit-2

MS

Preparation of documents that include text, tables, figures, calculation steps and formatting of such documents.

Unit-3

MS

To perform calculations for Chemical kinetics (zero and first order), Area under curve, Solubility, buffers, fitration, acid

Unit-4

Powerpoint presentations

Reference books:

1. "Computers Today" by Senders D. H., McGrawHill.
2. "Computer fundamentals" by P. K. Sinha. Third edition, BPB Publication.
3. "Information technology", Jaiswal, S., Galgotia Pub.
4. Manuals for MS DOS, MS Office, MS Windows, UNIX.
5. "Office 2000/2003 Complete", BPB Publication.
6. "Internet basic reference A to Z", by Falk B., BPB, Delhi
7. "Operating Systems" by Stallings,PHI.
8. "Computers in Pharmacy" by Thakur P.S.,ManchandaR.Nand P; Birla Pub.Pvt Ltd.
9. "Programming in ANSI-C by E. Balaguruswamy –Tata Mc. Graw Hill.
10. "Computer Networks" by Tenenbaum A.S., Prentice Hall of India.
11. "Programming with C" by Byron Gottfield.

PC-114 English & Communication Skill

RATIONALE : English Communications becoming the important skill for pharmaceutical professionals. Also at professional level the students good in communication have better career opportunities.

COURSE OBJECTIVES :

To learn basic communication skills(oral and written)

LEARNING OUT COMES :

The student should be able to communicate well both verbally and in written form at various levels such as at interviews, group discussion, letter writing, writing proposals etc.

PREREQUISITES : Basic English

SYLLABUS

Unit-1

English grammar- Parts of speech, articles, preposition, tenses, active and passive speech, direct and indirect speech.

Unit-2

Presentation techniques- Tips, Dos and don'ts of presentation, notice and placard presentations.

Unit-3

Written skills: Proposal, writing formats, report writing business letters, applications, covering letters, curriculum vitae designing, summary writing.

Unit-4

Listening- Phonetics and pronunciations (with the help of phonetics dictionary and with tapes from language laboratory).

Unit-5

Etiquettes and grooming.

Group discussion and extempore communication.

Interviews- Tips and model interviews (video shooting and display).

Reference Book:

1. Wren and Martin, English Grammar. Tapes from language laboratory, Hyderabad.

PC-115 Human Anatomy and Physiology

RATIONALE : The subject provides basic understanding structure and functions of the human body parts. The understanding of the subject will become the base for many subjects of the higher classes.

COURSE OBJECTIVES :

1. To understand structure and function of each body components from cellular level to system level.
2. To understand how functions of each cell is integrated to make the entire body function with complete co-ordination.
3. To understand the various diseases related to disturbances in the body function.
4. To learn fundamentals of health, various dimensions of health, understanding of basic terminologies related to epidemiology and disease management and parameters for measuring health.
5. To learn some simple first aid techniques and management of emergency situations.

LEARNING OUT COMES :

The student should be able to:

1. Draw and label the internal structure of cell, arrangement of tissues, important organs and body systems.
2. Narrate the functions of important organs and their sub parts.
3. Provide the basis for physiological variations.
4. Quantify the various components of blood and able to diagnose any abnormalities based on variations in the blood components.
5. Identify the important bones, body organs in the models.
6. Able to measure the radial pulse, Blood pressure and body temperature.
7. Take ECG tracings and describe the significance of each wave.
8. Explain the cause, transmission, prevention and management of common communicable diseases.
9. Define various terminologies used in health.
10. Narrate various macro and micro nutrients and provide the importance in maintenance of health.
11. Demonstrate the various first aid techniques used in emergencies.
12. Narrate the various contraceptive methods, the merits and demerits.

PREREQUISITES : Basic knowledge of arithmetic, physics and chemistry of H.S.C level.

SYLLABUS

Unit-1

a) Introduction & Scope of Human Anatomy & Physiology

Scope of anatomy and physiology and terminology used in these subjects.

Sense Organs: Basic anatomy and physiology of the eye (vision), ear (hearing), taste buds, nose (smell) and skin (superficial receptors).

b) Elementary tissues of the human body

Elementary tissues of the human body: Epithelial, connective muscular and nervous tissues, their sub

Structural & functional organization of cell, its components and functions: Body fluids & its composition, transport mechanisms across the cell membrane, Cell cycle.

Unit-2

a) Support & Movement

Osseous system: Structure, composition and functions of skeleton, classification of joints, types of movements at joints, Disorders of joints.

Skeletal muscles: Their gross anatomy, physiology of muscle contraction, physiological properties of skeletal muscle and their disorders.

b) Nervous System

Central Nervous System: Functions of different parts of brain and spinal cord. Neurohumoral transmission in the central nervous system, reflex action, electroencephalogram, cranial nerves and their functions.

Autonomic Nervous System: Physiology and functions of the autonomic nervous system. Mechanism of neurohumoral transmission in the A.N.S

Unit-3

Maintenance of Human body-I

Haemopoietic system: Composition and function of blood and its elements, their disorders, blood groups and their significance, mechanism of coagulation, disorders of platelets and coagulation.

Lymph and Lymphatic system: Composition, formation and circulation of lymph, disorders of lymphand lymphatic system. Basic physiology and functions of spleen.

Cardiovascular system: Basic anatomy of the heart, physiology of heart, blood vessels and circulation. Basic understanding of cardiac cycle, heart sound and electrocardiogram. Blood pressure and its regulation. Brief outline of cardiovascular disorders like hypertension, hypo tension, arteriosclerosis, angina, myocardial infarction, congestive heart failure and cardiac arrhythmia.

Respiratory system: Anatomy of respiratory organs, functions of respiration, mechanism and regulation of respiration, respiratory volumes and capacity.

Unit-4

Maintenance of Human body-II

Digestive System: Gross anatomy of the gastrointestinal tract functions of its different
those of liver, pancreas and gall bladder. Various gastro
absorption and digestion of food, disorders of digestive system.

Urinary System: Various parts, structures and functions of the kidney and urinary tract. Physiology of urine formation and acid base balance. Diseases of the urinary system.

Reproductive system: Male and Female reproductive system and their hormones. Physiology of menstruation, coitus and fertilization.

Endocrine System: Basic anatomy and physiology of pituitary, thyroid, Parathyroid, Adrenals, Pancreas, Testes and ovary, their hormones and functions.

Unit-5

Public Health, Diseases & awareness

Classification of food requirements, balanced diet, nutritional deficiency disorders, their treatment and prevention, specifications for drinking water.

Demography and family planning: Demography cycle, family planning, various contraceptive methods.
First Aid: Emergency treatment of shock, snake bites, burns, poisoning, fractures and resuscitation methods.

Reference books:

1. Anne M.R.Agur& Ming J. Lee: Grant's Atlas of Anatomy, Lippincott, Williams andWilkins B.D.Chaurasia's Human Anatomy (3 Volumes) CBS Publishers & Distributors.
2. B.Young, J.W.Heath: Wheater's functional Histology – a Text and Colour Atlas, ChurchillLivingstone.
3. Bullock B.L. &Henze R.L., Focus on Pathophysiology, Lippincott Chatterjee, C.C.Human Physiology (Medical Allied Agency, Calcutta).
4. Chummy S. Sinnatamby:Last's Anatomy – Regional and Applied, Churchill Livingstone.
5. Gandhi, T.P. et. al.: Human Anatomy, Physiology & Health Education (B.S.ShahPrakashan, Ahmedabad).
6. Garg K. et al. A Text Book of Histology (CBS Publishers, New Delhi).
7. Ghai, C.L.: A Textbook of practical physiology (Jaypee Brothers Medical Publisher (P)

PC-116 Practicals

RATIONALE : To provide the basic knowledge of very important concepts of all subjects and to provide overview of the applications of the concepts in applied field to the students is also an objective.

PREREQUISITES : Basic knowledge of arithmetic, physics and chemistry of H.S.C level.

Human Anatomy Physiology

1 Introduction to microscope.

2 To study the various tissue permanent slide (part I).

3 To study the various tissue permanent slide (part II).

4 Introduction to haemoglobinometer and haemocytometer.

Pharmaceutics (Basic Principles) Practical

1 To prepare the list of market products as per physical form.

2 To prepare the list of market products as per route of administration..

3 To study two component sysem –Preparation of eutectic mixture.(2)

4 To study the solubility relationship of 3-component system containing benzene, water and acetic acid

5 To study the mutual solubility of given liquids (phenol,water) and find out upper consolute temperature.

6 To determine Reynold's no. in given system.

7 To prepare Different pharmaceutical buffers.

8 To study the effect of pH on solubility of given drugs.

Chemistry

1. Introduction to laboratory and safety hazards.
2. Introduction to organic compound identification test.
3. Introduction to reagent test.
4. Introduction to functional group (I)to(V) and to identifies the give nunknown. (4-9).
5. Preparation of standard solutions.
6. Introduction to laboratory glasswares and analytical balance.
7. Preparation and standardization of sodium hydroxide.
8. Preparation and standardization of Hydrochloric acid.
9. To determine Normality, Molarity, %w/v, and gm/litre of any solution.
10. Standardization of analytical weights and calibration of volumetric apparatus.

Reference Books:

1. Manuals provided with the licensed version of the software.
2. Computer Applications and Basic Biostatistics : H.B.Bhadka, Dr. N.N.Jani, Dr. G.R.Kulkarni, Akshat Publications.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY
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Bechelor of Voction Programme

Pharmaceutical Chemistry
Syllabus / Scheme

SEMESTER-----II

WITH SEMESTER /CBCS/GRADING PATTERN

W. E. F. : Junuary-2015

Date : 27- 02- 2015

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Hemchandracharya North Gujarat University, Patan

UGC Approved

Bachelor of Vocation (B. Voc.)

in

Pharmaceutical Chemistry

Curriculum for Semester II

Semester II

Course Code	Course Title	Credit		Total
		Theory	Prac./Field	
PC 211	Fundamentals of Organic Chemistry	3	0	3
PC 212	Physical Chemistry	2	0	2
PC 213	Fundamental Biochemistry	2	0	2
PC 214	Analytical Chemistry	3	0	3
PC 215	Fundamentals of Pharmacognosy	2	0	2
PC 216	Practical	--	18	18
Total		**12**	**18**	**30**

PC-211 Fundamental of Organic Chemistry

SUBJECT CODE: PC 211

RATIONALE: Majority of the drugs used are organic in nature and therefore understanding the basics of organic chemistry, naming these complex chemical structures, understanding the chemical and physical properties of the common groups of compounds and also doing synthesis of these compounds becomes very important in understanding drug properties.

COURSE OBJECTIVES :

1. To learn fundamentals of chemical bonds, stereochemistry.
2. To learn basic chemical functional groups of compounds with respect to their physical and chemical properties.
3. To learn the simple organic chemical reactions.
4. To identify organic compounds by testing their physical and chemical properties.

LEARNING OUTCOMES :

The student should be able to:

1. Define and explain different types of chemical bonds.
2. Name the organic compounds according to IUPAC nomenclature system.
3. Narrate physical and chemical properties of different compounds representing different functional group.
4. Write chemical reactions depicting synthesis and chemical properties of these organic compounds.
5. Synthesis some organic compounds.
6. Identify unknown organic compounds by conducting different physical and chemical tests.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 211	Fundamental of Organic Chemistry	3	3 -	50	50	100

Unit-1

Basics

Molecular orbitals, Bonding and Antibonding orbitals, Covalent bond, Hybrid orbitals, Intramolecular forces, Bond dissociation energy, Polarity of bonds, Polarity of molecules, structure and physical properties, Intermolecular forces, Acids and bases, general nomenclature.

Unit-2

Stereochemistry

Stereochemistry: Isomerism and nomenclature and associated physicochemical properties, optical activity, stereoisomerism, specification of configuration, Reactions involving stereoisomers, chirality, chiral reagents conformations, stereochemistry of specific reactions and intermediates, Stereoselective and stereospecific reactions.

Unit-3

Structure, Nomenclature, Preparation and Reactions

Structure, Nomenclature, Preparation and Reactions of: Alkanes, Alkenes, Alkynes; Cycloackanes, Dienes, Benzene, Polynuclear aromatic compounds, Arenes, Alkyl halides, Alcohols, Ethers, Epoxides, Amines, Phenols, Aldehydes and ketones, Carboxylic acids, Functional derivatives of carboxylic acids, Reactive intermediates – carbocations, cabanions, carbenes, nitrene and nitrenium ions.

Recommended Books for the syllabi are:

1. Morrison & Boyd, Organic Chemistry, Prentice-Hall, 6th, 2001.
2. March J, Advanced Organic Chemistry, MacGraw-Hill, 3rd, 1985.

Reference Books:

1. Solomon & Fryhle, Organic Chemistry, Wily, 8th, 2004.
2. Shriner & Morill, The systemic Identification of Organic Compounds, Wily, 8th, 2004.
3. Furniss, Vogel's Textbook of Practical Organic Chemistry, Pearson education, 5th, 2004.
4. Eliel E, Stereochemistry of Carbon Compounds, McGraw-Hill, 7th, 1962.
5. Eliel E, Elements of Stereochemistry, wily, 3rd, 1969.
6. Cahn & Dermer, Introduction to Chemical Nomenclature, Butterworths, 3rd, 1979.
7. Warren S, Organic synthesis-The disconnection approach, Wily, 4th, 1982.
8. Wheland G Advanced Organic Chemistry, Wily, 3rd, 1960.
9. Kagan H, Organic Stereochemistry, Wily, 4th, 1965.
10. House H, Modern Synthetic Reactions, Wily, 2nd, 1972.

PC-212 Physical Chemistry

SUBJECT CODE : PC 212

RATIONALE: Physical properties of drugs and chemicals have immense effect on drug manufacturing, efficacy and stability. Strong knowledge of these subjects becomes mandatory for any professional.

COURSE OBJECTIVES :

1. To learn the important physical properties of drugs and chemicals, that can significantly affect the drug manufacturing.
2. To quantify these physical properties and methods to alter the same so as to avail desired levels.

LEARNING OUTCOMES :

The student should be able to:

1. Define and explain the various physical properties.
2. Measure the physical properties and demonstrate the methods to alter the same by different ways.
3. Narrate and explain the laws, theories pertaining to these properties.
4. Carry out simple calculations involved with these properties.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 212	Physical Chemistry	2	2	50	50	100

Unit-1

Gaseous and solid state chemistry

Behavior of Gases: Kinetic theory of gases, deviation from behaviors and explanation.

Solid State: Crystalline structures, lattices, physical properties.

Adsorption: Freudlich and Gibbs adsorption isotherms, Langmuir theory of adsorption.

Unit-2

The Liquid State

The Liquid State: Physical properties (surface tension, perachor, viscosity, refractive index, optical rotation, dipole moments and chemical constituents).

Solutions: Ideal and real solutions, solutions of gases in liquids, colligative properties, partition coefficient, conductance and its measurement, Debye Huckel theory.

Unit-3

Thermodynamics

11. P.W. Atkins, Physical Chemistry, 5th Edition, Oxford University Press, UK, 1994.
12. P.S. Rachavan, M.S. Shethi, Concepts and Problems in Physical Chemistry, 1st Edition, Discovery Publishing House, New Delhi, 1997.
13. A.W. Adamson, Physical Chemistry of Surfaces, 5th Edition, A Wiley Interscience Publication, New York, 1990.
14. C.K. Vemulapathi, Physical Chemistry, 1st Edition, Prentice-Hall of India Pvt. Ltd., New Delhi, 1997.
15. C.R. Metz, Schaum's Solved Problems Series, 2000 solved problems in Physical Chemistry, 2nd Edition, Megraw Hill Publishing Company, USA, 1989.
16. R. Chang, Physical Chemistry with Applications to Biological Systems, 2nd Edition, Macmillan Publishing Co., New York, 1981.
17. Prof. S.K. Dutta, Principles of Physical Chemistry and Biophysical Chemistry, 1st Edition, Books and Allied (P) Ltd., Kolkata, 2007.

Thermodynamics: first, second and third laws, Zeroth law, absolute temperature scale, thermo chemical equations, phase euqilibria and phase rule.

Unit-4

Photochemistry

Photochemistry: Consequences of light absorption, Jablenski diagram, Lambert-Beer Law, Quantum efficiency.

Unit-5

Chemical Kinetics

Chemical Kinetics: Zero, first and second order reactions, complex reactions, theories of reaction Kinetics, characteristics of homogeneous and heterogeneous catalysts, acid base and enzyme catalysis.

Recommended Books for the syllabi :

1. G. Raj, Advanced Physical Chemistry, 20th Edition, Goel Publishing House, Meerut, 1996-97.
2. Dr. J.N. Gurtu, Dr. Hemant Snehi, Advanced Physical Chemistry, 7th Revised and Enlarged Edition,Pragati Prakashan, Meerut, 2000.
3. P.L. Soni, O.P. Dharmarha, U.N. Dash, Textbook of Physical Chemistry, 22nd Edition, Sultan Chand and Sons, New Delhi, 2001.

Reference Books:

1. B.S. Bahl, G.D. Tuli, Arun Bahl, Essentials of Physical Chemistry, Reprinted 24th Edition, S. Chand and Company Ltd., New Delhi, 2004.
2. L.M. Atherden, Bentley and Driver's Textbook of Pharmaceutical Chemistry, 8th Edition, Oxford University Press, Bombay, 1994.
3. S. Glasstone, Textbook of Physical Chemistry, 2nd Edition, Rajiv Beri for Macmillan India Limited, New Delhi, 1995.
4. J. B. Yadav, Advanced Practical Physical Chemistry, 15th Edition, Goel Publishing House, Meerut, 1997.
5. W. J. Moore, Physical Chemistry, 5th Edition, Orient Longman Pvt. Ltd., New Delhi, 2004.
6. I. Das, A. Sharma, N. R. Agrawal, An Introduction to Physical Chemistry, Revised 2nd Edition, New Age International Publishers, New Delhi, 2005.
7. B. Viswanathan, P.S. Raghawan, Practical Physical Chemistry, 1st Edition, Viva Books Pvt. Ltd., 2005.
8. D.P. Shoemaker, C.W. Garland, J.W. Nibler, Experiments in Physical Chemistry, 5th Edition, Megraw Hill International Edition, New York, 1989.
9. S. Glasstone, D. Levis, Elements of Physical Chemistry, 2nd Edition, Macmillan and Company Limited, 1970.
10. R.M. Verma, A Textbook of Physical Chemistry, Volume – I & II, 1st Edition, CBS Publishers and Distributors, Delhi, 1992.

PC-213 Fundamental Biochemistry

SUBJECT CODE : PC 213

RATIONALE : Understanding the chemistry of life is fundamentally required for studying the effect of drugs on human body. The course will enable student to learn the basic chemical reactions occurring in the human body. Also the various factors which can regulate this chemical processes will be taught.

COURSE OBJECTIVES :

1. To learn the structure and function of various biochemical.
2. To learn the basic metabolic processes occurring within the human body and factors regulating the same.

LEARNING OUTCOMES :

The student should be able to:

1. Describe the structure and functions of various biochemical.
2. Describe the various biochemical pathways occurring within the human body.
3. Describe the basic principles of enzymology.
4. Classify the different enzymes.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 213	Fundamental Biochemistry	2	2	50	50	100

Unit-1

Biological macromolecules: carbohydrates

Introduction to carbohydrates, Nomenclature, definition and classification of carbohydrates, Monosaccharides, Classification, structural aspect and biological significance, Disaccharides, Oligosaccharides, Polysaccharides.

Unit-2

Introduction to lipids

Structure and function diversity of lipids, Definition and classification, Fatty acids, Triacyl glycerols, glycerophospholipids, Sphingolipids, steroids and other biologically important lipids (Terpenes, steroids, cholesterol etc)

Unit-3

Proteins

Proteins, structure and function, General structure of Amino acids, Classification of Amino acids, Peptide bond link amino acids in proteins, Composition of amino acid in protein and determining sequence of amino acid residue, Structure of protein, Types of protein structure, Primary structure, Secondary structure, Tertiary structure, Quaternary structure, Various other biologically important protein.

Unit-4

Enzymes and co-enzymes

Structure and function of enzyme, Classification of enzyme, Enzyme kinetics and its mechanism of action Enzyme inhibition, Types of enzyme inhibition, Reversible enzyme inhibition, Irreversible enzyme inhibition, Regulation of enzyme activity, Enzymes and iso enzymes in clinical diagnosis. Coenzyme classification, Role of vitamin as coenzyme, Biological significance, Metal as coenzyme and its biological significance.

Recommended Books for the syllabi:

1. Dr. U. Satyanarayana, Biochemistry, 2nd edition, Books and allied (P) Ltd., 2004.
2. A. White, Philip Handler, E.L. Smith, R.L. Hill, I.R. Lehman, Principles of Biochemistry, 6th edition, Tata McGraw Hill Publishing Company Ltd., 2004.
3. D. L. Nelson, M. M. Cox, Lehninger Principles of Biochemistry, 4th edition, W. H. Freeman & Company, 2005.

Reference Books:

1. P.C. Champe, R.A. Harvey, Biochemistry, 2nd edition, Lippincott – Raven publishers, 1994.
2. R. K. Murray, D.K. Granner, P.A. Mayes, V.W. Rodwell, Harper's Illustrated Biochemistry, 26th edition, McGraw Hill Publishers, 2003.
3. W. H. Elliott, D. C. Elliott, Biochemistry & Molecular Biology, 1st edition, Oxford University Press, 1997.
4. G. L. Zubay, W. W. Parson, D.E. Vance, Principles of Biochemistry, 1st edition, WCB publishers, 1995.
5. E.E. Conn and P.K. Stumpf, G. Bruening, R. H. Doi, Outlines of Biochemistry, 5th edition, John Wiley & Sons, New York, 1999.
6. D. B. Marks, Board Review Series, Biochemistry, 2nd edition, Harwal Publishing, 1994.
7. R. H. Garrett, C. M. Grisham, Principles of Biochemistry with a Human Focus, 1st edition, Harcourt College Publishers, 2002.
8. M. Cohn, K.S. Roth, Biochemistry and Disease, 1st edition, William and Wilkins Co., Baltimore, 1996.
9. H. R. Horton, L. A. Moran, R. S. Ochs, J. D. Rawn, K. G. Scrimgeour, Principles of Biochemistry, 2nd edition, Prentice-Hall International Inc., 1996.
10. S. Ramakrishnan, K.G. Prasanan, R. Rajan, Textbook of Medical Biochemistry, 3rd Edition, Orient Longman, Madras, 2001.

PC-214 Analytical Chemistry

SUBJECT CODE: PC 214

RATIONALE : Measuring Drug purity is a primary requirement to ensure the quality of drugs. Quantifying the purity of compound can be done by different techniques. Some of the most commonly used techniques will be taught in this subject. This will make the student capable to work in a quality control department of the pharmaceutical industry.

COURSE OBJECTIVES

1. To make student learn the basic principles of various assay techniques commonly used in quality control department of any pharmaceutical industry.
2. To provide the hands-on experience by actually conducting these assays in the lab.

LEARNING OUTCOMES

The student should be able to:

1. Correctly sample the drug for testing
2. Carry out calculations involved in basic statistics.
3. Narrate the principles of methods and instruments used in assay of various drugs and chemicals.
4. Conduct assays of some drugs using these methods and instruments.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 214	Analytical Chemistry	3	3	50	50	100

Unit-1

Errors and statistics

Types of error, Precision and accuracy, Mean and Standard deviation, Confidence interval, Comparison of results and means of two samples, Paired T-test, Q-test, Correlation and linear regression, comparison of more than two means, Significant figures, Rules for retaining significant digits.

Unit-2

Sampling

Basis of sampling, sampling procedure and selection of sample, factors affecting sampling: sampling and physical state, crushing, grinding and hazards in sampling.

Unit-3

Introduction to titrimetric analysis:

Significance of quantitative analysis in quality control, Different techniques of analysis, Preliminaries and definitions, Fundamentals of volumetric analysis, methods of expressing concentration, primary and secondary standards.

Unit-4

Errors and Statistical Data Treatment of Analytical Results

Introduction to Analytical Chemistry, Classification of Classical and Electroanalytical Techniques, Literature of Analytical Chemistry (Names of Author and Publishers for any Ten Books, Journals and Reviews), Criterion for Selection of analytical Techniques, Analytical Data Treatment, Error, Types of errors, Accuracy and Precision, Statistical Terms :Mode, Average, Median, Deviation, Average Deviation, Relative Average Deviation, Standard Deviation & Coefficient of variance, Q-Test for the rejection of result and related numerical.

Recommended Books for the syllabi are:

1. Vogel's Text book of Quantitative Chemical Analysis, J. Mandham, R.C. Denney, J.D. Bernes, M.J.K. Thomas, 5th Edition, ELBS, UK, 1996.
2. G.D. Christian, Analytical Chemistry, 5th Edition, John Wiley & Sons, New York, 1994.
3. D.A. Skoog, D.M. West, F.J. Holler, Analytical Chemistry: An Introduction, 6th Edition, Saunders College Publishing, New York, 1994.
4. J.A. Dean, Analytical Chemistry Handbook, 1st Edition, Mc Graw Hill Inc., New York, 1995.

Reference Books:

1. Dr. A.V. Kasture, Dr. K.R. Mahadik, Dr. S.G. Wadodkar, Dr. H.N. More, A Textbook of Pharmaceutical Analysis, Volume – I, 8th Edition, Nirali Prakashan, Pune, 2002.
2. R.A. Day and A.L. Underwood, Quantitative Analysis, 6th Edition, Prentice-Hall of India Pvt. Ltd., New Delhi, 1993.
3. K.A. Connors, A Textbook of Pharmaceutical Analysis, 3rd Edition, John Wiley & Sons, New York, 1982.
4. J.H. Kennedy, Analytical Chemistry Principles, 2nd Edition, Saunders College Publishing, New York, 1990.
5. D.A. Skoog, D.M. West, F.J. Holler, Fundamentals of Analytical Chemistry, 7th Edition, Saunders College Publishing, New York, 1996.
6. The Indian Pharmacopoeia 2007, Volume-I,II & III, Conteoller of Publication, 2007.
7. R.M. Verma, Analytical Chemistry, 2nd Edition, CBS Publishers, New Delhi, 1991.
8. S.M. Khopkar, Basic Concepts of Analytical Chemistry, 2nd Edition, New Age International Publishers, New Delhi, 1998.
9. A.H. Backett, J.B. Stenlake, Practical Pharmaceutical Chemistry, 4th Edition, CBS Publishers, Delhi, 1997.
10. V. Alexeyev, Quantitative Chemical Analysis, 1st Edition, Mir Publishers, Moscow, 1994.
11. I.M. Pande, Systemic Analytical Chemistry, 1st Edition, Central Book Depot, Allahabad, 1965.
12. R. Kellner, J.M. Mermet, M. Otto, H.M. Widmer, Analytical Chemistry, 1st Edition, Wiley-VCH, 1998.
13. T. Higuchi, Pharmaceutical Analysis, 1st Edition, CBS Publishers, New Delhi, 1997
14. P.D. Sethi, Quantitative Analysis of Drugs in Pharmaceutical Formulations, 3rd Edition, CBS Publishers, New Delhi, 1997.

15. F.W. Fifield, D. Kealey, Principle and Practice of Analytical Chemistry, 5th Edition, Blackwell Science Ltd., 2000.
16. Y. Anjaneyulu, K. Chandrasekhar, Valli Manickam, A Textbook of Analytical Chemistry, 1st Edition, Pharma Book Syndicate, Hyderabad, 2006.

PC-215 Fundamentals of Pharmacognosy

SUBJECT CODE : PC 215

RATIONALE : It provides knowledge of drugs of natural origin. Since ages humans have been using drugs from natural origin. Many of the allopathic drugs also have herbal origin. Learning these drugs is of great value for pharmacy professionals as these drugs have important place in treatment of diseases.

COURSE OBJECTIVES :

1. To learn general morphological and microscopically characters of crude drugs.
2. To understand general methods of checking purity of herbal drugs.

LEARNING OUTCOMES :

The student should be able to:

1. Explain structure and function of plant tissues.
2. Describe and demonstrate the morphological characters of different parts of plants.
3. Describe taxonomical characters of plants belonging to some important plant families.
4. Classify plant derived drugs.
5. Demonstrate different tests used for quality control of herbal drugs.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 215	Fundamentals of Pharmacognosy	2	2	50	50	100

Unit-1

Introduction to Pharmacognosy

Definition, scope, history and development of Pharmacognosy, introduction to secondary metabolites – Definition & classification.

Unit-2

Plant tissue & Morphology

Plant tissue of simple and complex and tissue system, morphology of root, stem, bark, wood, leaf, flower, fruit and seed, modification of root, stem and leaf, histology of root, stem and leaf.

Unit-3

Plant taxonomy

Study of the following families with special reference to medicinally important plants – Malvaceae, Apocynaceae, Solanaceae, Leguminosae, Rubiaceae. sources of crude drugs & Classification of crude drugs

Unit-4

Classification and cultivation of crude

Sources of crude drugs & Classification of crude drugs, cultivation, collection, processing and storage of crude drugs: importance and factors, influencing cultivation of medicinal plant, quality control of crude drugs: Adulteration and evaluation.

Unit-5

Carbohydrates and derived products

Definition, classification & chemical tests of carbohydrates; Agar, Guar gum, Acacia, Honey, Isabgol, pectin, Starch and Tragacanth.

Recommended Books for the syllabi are:

1. Atal C.K. And Kapur B.M., Cultivation and Utilization of Medicinal Plants, Rrl Jammu.
2. Quadry J.S, Shah and Qadry Pharmacognosy, B.S.Shah Publication.
3. MG Chauhan, Microscopy of Leaf Drug, Jamnanagar Ayurved University.
4. Iyengar, Text Book of Pharmacognosy, Manipal Power Press.

Reference Books:

1. Rangari & Rangari, Text Book of Pharmacognosy.
2. Datta A.C., A Class Book of Botany, Oxford Uni.
3. Bendre A. M, Ashokkumar, A Textbook of Practical Botany Ii Rastogi Publications, Meerut, India.
4. Wallis T.E., Text Book of Pharmacognosy, 5th Edition, Cbs Publishers and Distributors.
5. Kokate C.K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
6. Kokate C.K, Purohit A.P. And Gokhale S.B. Pharmacogonosy (Degree) Nirali Prakashan, Pune.
7. Khandelwal K R. Practical Pharmacognosy, Nirali Prakashan.
8. Trease E and Evans W.C., Pharmacognosy, Balliere Tindall. Eastbourne, U.K.
9. Tyler V.C., Brady L.R. And Robers W.E. , Pharmacognosy, Lea And Febiger, Ph.
10. MG Chauhan, Microscopy of Bark Drug, Jamnanagar Ayurved University.
11. Jackson Betty P., Atlas Of Microscopy Of Medicinal Plants, Culinary Herbs And Spices, CBS publication.

PC-216: Practical

SUB CODE	TITLE OF SUBJECT	Credit	EVALUATION SCHEME	Total Marks
			Practical	
			External	
PC 216	Practical	18	600	600

Practical:

1. Introduction to laboratory and safety hazards.
2. Introduction to organic compound identification test.
3. Introduction to reagent test.
4. Introduction to functional group (I) to (V) and to identifies the given unknown. (4-9).
10. To synthesize acetanilide from aniline.
11. To synthesize p – bromo acetanilide from acetanilide.
12. To synthesize p – bromo aniline from p – bromo acetanilide.
13. To synthesize Benzoic acid from benzamide or phenyl benzoate
14. To synthesize Benzamide from benzoyl chloride.
15. To determine the viscosity and specific gravity of the given liquids.
16. To determine the surface tension of the given liquids.
17. To study the effect of temperature on viscosity and surface tension of the given liquids.
18. To check the validation of Freundlich and Langmuir adsorption isotherm using charcoal and acetic acid.
19. Preparation and standardization of sodium hydroxide.
20. Preparation and standardization of Hydrochloric acid.
21. To determine Normality, Molarity, %w/v, and gm/litre of any solution.
22. Standardization of analytical weights and calibration of volumetric apparatus.
23. Non-aqueous titrations: Preparation and standardization of perchloric acid and sodium/potassium/lithium methoxides solutions; Estimations of some Pharmacopoeial products.
24. Care, use and types of microscopes and Preparation of different types of slides and Study of different cell and tissue system.
25. Microscopical examination of cell contents: starch grains, calcium oxalate & carbonate crystals and phloem fibres. & stomatas.
26. Morphology of plant parts indicated in theory.
27. Microscopic examination of stem monocot and dicot plants.
28. Microscopic examination of root monocot and dicot plants.
29. Microscopic examination of leaf monocot and dicot plants.
30. Morphological characteristic of plant family Solanaceae.
31. Quantitative microscopy Leaf constants.
32. Quantitative microscopy Dimention measurement.
33. To study morpholgy and chemical tests of cabohydrate containing drug.
34. Preparation of herbarium sheets.

Hemchandracharya North Gujarat University, Patan

Bachelor of Vocation

Programme on

Pharmaceutical Chemistry

Sem - 3 To 6 W.E.F : June-2015

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Preface

The University Grants Commission (UGC) has launched a scheme on skills development based higher education as part of college/university education, leading to setting up of Bachelor of Vocation courses (B.Voc.) to serve multiple needs, including (i) career oriented education and skills to students interested in directly entering the workforce; (ii) contracted training and education programmes for local employers; (iii) high-touch remedial education for secondary school graduates not ready to enroll in traditional colleges, giving them a path to transfer to three or four year institutions; and (iv) general interest courses to the community for personal development and interest. Bachelor of Vocation will have with multiple exits such as Diploma and Advanced Diploma under the NSQF (National Skills Qualifications Framework).

The Bachelor of Vocation model, by and large, will be accessible to a large number of individuals of the community, offer low cost and high quality education locally, that encompasses both vocational skills development as well as traditional coursework, thereby providing opportunities to the learners to move directly to the employment sector or move into the higher education sector. It offers a flexible and open education system which also caters to community-based life-long learning needs.

About the programme

The program is designed to educate and create skilled manpower that can serve the society through the knowledge gained during the course of time. The student enrolling in the course will be benefitted in several ways. The candidate will work in the college as well as with the industries during the time of his study. If a candidate successfully completes first year of study he would be awarded a diploma and he will be capable enough to serve as a laboratory assistant in any industry or academic institution. A candidate completing two successful years in Bachelor of Vocation program will be awarded with advanced diploma. An advanced diploma qualified student in Pharmaceutical Chemistry will be fit for working in ADL, QC and Production department of any pharmaceutical industries. The candidate completing all three years of the course successfully will be awarded with Bachelor of Vocation in Pharmaceutical Chemistry and is fit for getting absorbed in any division of Pharmaceutical Industries.

BVPCR1: Eligibility Criteria (EC) for Admission

1. The eligibility conditions for admission to the program will be 10+2 or equivalent in science stream or diploma chemical or diploma pharmacy
2. If the candidate has attained the specific level 4 of NOS of pharmaceutical chemistry sector (by decision of equivalence committee of the college) can get admitted in B.Voc. for the programme
3. There is no age bar for admission to Bachelor of Vocation
4. The student can take exit from this course at any point of time and can get re-entry in this programme. Such students will get priority in admission than to a fresher student. (multi entry multi exit scheme)

BVPCR2: Admission Procedure

1. For admission to the programmes offered, preference should be given to the learners living in the local community. Reservation to SC, ST, OBC and PwD categories will be available as per the extant national / State policy.
2. Admissions may be done on a rolling basis depending on the duration of the programmes to facilitate a steady stream of learners joining the college and moving out as trained work force to the job market, round the year and not just once in a year.
3. The applicants seeking re-entry into the college should get preference in admission over the new applicants.
4. Candidates are selected on the basis of Merit.

BVPCR3: Fees and Scholarship:

1. Student fee should be decided as per the prevalent practice for fee fixation for aided courses.
2. Attempt should be made to recover part of the operating expenditure from the student fees.

BVPCR4: Registration / Enrollment:

1. Every student admitted to the college for the programme must get enrolled to university within a month from the date of admission.

BVPCR5: Semester Examinations

1. Candidates desirous of appearing at any Semester Examination shall have to submit applications in the prescribed form, through the designated authority on or before the prescribed date.
2. No candidate will be admitted to any Semester examination unless the Designated Authority i.e. the Head of the Department or Principal of the College certifies that:

   (1) The candidate attended the course of study to the satisfaction of the designated authority.

   (2) The candidate maintained a good conduct and character during the studies.

   (3) The candidate maintained minimum 80% attendance in each semester

BVPCR6: Evaluation

1. Appropriate mechanism for assessment of the learners' progress towards acquisition of knowledge and skill should be developed by the College. Partner industries should also be given a clear and well defined role in the assessment of the learners.
2. Practical or hands on skills should be given comparatively more weightage in the overall assessment plan.
3. The College should adopt and integrate the guidelines and recommendations of the respective Sector Skill Councils (SSCs) for the assessment and evaluation of the vocational component, wherever available. They should also involve the SSCs in the assessment process, wherever required. It applies to colleges, both Autonomous and non-Autonomous, and universities to maintain Occupational Standards and the fitness for the job.
4. Theory of each CORE paper will be evaluated for a maximum of 100 marks out of which, 50 marks shall be for Internal Examination and 50 marks for the end semester examination. An end semester examination shall be of 2 hours duration.
5. Practical as a combined form for Each core paper will be evaluated for a maximum of 700 marks out of which, 500 marks shall be continuous internal evaluation and 200 marks for the end semester practical examination.

6. Paper PC 113 and PC 114 of semester I is evaluated for a maximum of 100 marks which will be evaluated internally by continuous evaluation.

BVPCR7: rules for grading

1. One Credit would mean equivalent of 14-15 periods of 60 minutes each, for theory, workshops / labs and tutorials per semester.
2. For internship / field work, the credit weightage for equivalent hours shall be 50% of that for lectures / workshops
3. For self-learning, based on e-content or otherwise, the credit weightage for equivalent hours of study shall be 50% of that for lectures / workshops
4. To pass a subject in any Semester a candidate must obtain a minimum of 40% of marks in each paper.
5. If a candidate fails in any subject, he has to reappear for that particular paper and pass. (That is, for example if candidate fails in midterm exam of a subject, he has to reappear for midterm of that subject.)
6. The performance of each candidate in all the subjects will be evaluated on 7- point scale in term of grades as follow:

Grading Scheme		%age according to Grade	Grade Points	Qualitative Meaning of Grade
1	A +	90-100	10.0	Outstanding
2	A	80-89	9.0	Excellent
3	A-	70-79	8.0	Very Good
4	B +	60 – 69	7.0	Good
5	B	50-59	6.0	Average
6	B-	40-49	5.0	Fair
7	F	Less Than 40	0	Fail
8	I	Incomplete		

BVPCR8: performance index

1. The performance of a student in a semester is expressed in terms of the **Semester Performance Index (SPI).**

   SEMESTER PERFORMANCE INDEX (SPI)

   The Semester Performance Index (SPI) is the weighted average of Course Grade Points obtained by the student in the semester. The Weights assigned to Course Grade Points are the Credits carried by the respective courses.

   $$SPI = \frac{g1\,c1 + g2\,c2 + \ldots}{c1 + c2 + \ldots\ldots}$$

   Where, g 1 , g 2 ..... are the Grade points obtained by the student in the Semester, for Courses carrying Credits c 1 , c 2 .....respectively.

2. The cumulative performance of a student at the end of the Semester / Course is expressed in terms of the **Cumulative Performance Index (CPI).**

   CUMULATIVE PERFOMANCE INDEX (CPI)

   This index is defined as the weighted average of Course Grade Points obtained for all the weights for Theory Papers (Both Mid Term & End Term) and Practicals attempted since his admission to the program, where the weights are defined in the same way as in **Semester Performance Index (SPI).**

3. If a failed student repeats a course, only the Grade Points obtained in the latest attempt shall be counted in the **Cumulative Performance Index**. Whenever the candidate clears the subject in the next semester examination, the total credits for that subject will be added to CPI.

4. For any Semester, the maximum marks for the Mid Term and End Term assessments are shown in the teaching and examination scheme. For the purpose of Mid Term assessment, tests, quizzes, assignments or any other suitable methods of assessment may be used by the department.

BVPCR9: semester passing scheme

1. For each semester examination, a candidate will be considered as pass if he/she has secured "B-" or above grade in all the subject (s) and overall grade point 5.00 or above.

2. For each semester examination, a candidate will be considered as fail if he/she has secured "F" grade in any or all the subject (s).
3. If the candidate does not fulfill the subject requirements including requisite attendance percentage, he/she will be given I grade and the candidate will have to complete the course requirements before the commencement of the next End Semester examination. If the candidate does not clear I grade in any subject before the commencement of the next End Semester examination, he/she will be considered fail - F grade.
4. Candidate has to clear his / her 'F' grade or 'I' grade, if any, by the next End Semester examination.

BVPCR10: semester promotion scheme

A candidate will be promoted to the subsequent Semester according to the following scheme:

1. A candidate would be granted admission to the Second Semester if and only if he/she has been granted Term for First Semester and has applied for the university examination.
2. A candidate would be granted admission to the Third Semester if and only if he/she has been granted Term for First & Second Semesters and has applied for the university examination.
3. A candidate would be granted admission to the Fourth Semester if and only if he/she has cleared all the subjects of First Semester. He /She will be permitted to pursue his/her study of Fourth Semester, provided his/her term for II & III Semesters is granted and has applied for the university examination.

Promotion Criteria

Semester	Condition(s) For Promotion
II	Grant of Term for Semester – I
III	Grant of Term for Semester I and Semester II
IV	Clearing of Semesters I completely and Grant of Term for Semester II & Semester III

V	Clearing of Semesters II completely and Grant of Term for Semester III & Semester IV

VI	Clearing of Semesters III completely and Grant of Term for Semester IV & Semester V

BVPCR11: award of grading / division

No class/ division will be awarded to the students in the first 5 semesters. Divisions shall be awarded only at the end of Final Examinations on successful completion of all the Semesters. For awarding the degree at the end of the course, Cumulative Performance Index (CPI) of all the Mid Term and Final exams shall be taken in to consideration as per the following pattern of **Cumulative Performance Index (CPI)**:

S.N.	CPI	Division
1	7.50 to 10.00	FIRST Division with Distinction
2	6.50 to 7. 49	FIRST Division
3	6.00 to 6. 49	SECOND Division

BVPCR12: award of degree

1. Award of Certificate, Advanced certificate, Diploma or Advanced Diploma, as the case may be, would depend on acquisition of requisite credits as prescribed by the certification body and not on the duration of the calendar time spent in pursuing the course.
2. The certificate shall mention the credits earned, course duration (in hours), and the curriculum covered. If the course is aligned with NVEQF / NSQF, the corresponding NVEQF / NSQF level should also be mentioned on the certificate.
3. Award of degree will be as follows

NVEQF Level	Skill Component Credits	General Education Credits	Normal calendar duration (post meeting the entry criterion)	Awards
7	-		Six semesters	Bachelor of Vocation
6	72	48	Four semesters	Advanced Diploma
5	36	24	Two semesters	Diploma
	18	12	One semester	Advanced Certificate
	9	6	Three Months	Certificate

B.VOC.PHARMACEUTICAL CHEMISTRY
COURSE STUCTURE

SEM I

Course Code	Course Title	Credit		Total	Credit	Marks		Total
		Theory	Prac./Field	Theory	Prac./Field	Internal	External	
PC 111	Basic Pharmaceutical Calculations	2	0	2	0	50	50	100
PC 112	Pharmaceutics (Basic Principles)	3	0	3	0	50	50	100
PC 113	Basic Computer Applications	2	0	2	0	100	-	100
PC 114	English and Communication Skill	2	0	2	0	100	-	100
PC 115	Human Anatomy and Physiology	3	0	3	0	50	50	100
PC 116	Practical	--	18	--	18	500	200	700
Total		**12**	**18**	**12**	**18**	**850**	**350**	**1200**

SEM II

Course Code	Course Title	Credit		Total	Credit	Marks		Total
		Theory	Prac./Field	Theory	Prac./Field	Internal	External	
PC 211	Fundamentals of Organic Chemistry	3	0	3	0	50	50	100
PC 212	Physical Chemistry	2	0	2	0	50	50	100
PC 213	Fundamental Biochemistry	2	0	2	0	50	50	100
PC 214	Analytical Chemistry	3	0	3	0	50	50	100
PC 215	Fundamentals of Pharmacognosy	2	0	2	0	50	50	100
PC 216	Practical	--	18	--	18	500	200	700
Total		**12**	**18**	**12**	**18**	**750**	**450**	**1200**

SEM III

Course Code	Course Title	Credit		Total	Marks		Total
		Theory	Prac./Field	Theory	Internal	External	
PC 311	Advanced Organic Chemistry	3	0	3	50	50	100
PC 312	Advanced Analytical Chemistry-I	3	0	3	50	50	100
PC 313	Cell Biology	2	0	2	50	50	100
PC 314	Indian Drugs Regulatory Guidelines	2	0	2	50	50	100
PC 315	Pharmaceutical Inorganic Chemistry	2	0	2	50	50	100
PC 316	Practical	--	18	--	500	200	700
Total		**12**	**18**	**30**	**750**	**450**	**1200**

SEM IV

Course Code	Course Title	Credit		Total	Marks		Total
		Theory	Prac./Field		Internal	External	
PC 411	Medicinal Chemistry –I	3	0	3	50	50	100
PC 412	Microbiology	2	0	2	50	50	100
PC 413	Advanced Analytical Chemistry-II	3	0	3	50	50	100
PC 414	Pharmaceutics- Unit operation	2	0	2	50	50	100
PC 415	Pharmacy Practice	2	0	2	50	50	100
PC 416	Practical	--	18	18	500	200	700
Total		**12**	**18**	**30**	**750**	**450**	**1200**

SEM V

Course Code	Course Title	Credit		Total	Marks		Total
		Theory	Prac./Field		Internal	External	
PC 511	Medicinal Chemistry-II	3	0	3	50	50	100
PC 512	Advanced Analytical Chemistry-III	3	0	3	50	50	100
PC 513	Pharmacology -I	3	0	3	50	50	100
PC 514	Introduction to Drug Delivery Systems	3	0	3	50	50	100
PC 515	Practical	--	18	18	500	200	700
Total		**12**	**18**	**30**	**700**	**400**	**1100**

SEM VI

Course Code	Course Title	Credit		Total	Marks		Total
		Theory	Prac./Field		Internal	External	
PC 611	Basic Principles of Cosmetic Products	2	0	2	50	50	100
PC 612	Medicinal Chemistry – III	3	0	3	50	50	100
PC 613	Advanced Analytical Chemistry-IV	3	0	3	50	50	100
PC 614	Pharmacology II	2	0	2	50	50	100
PC 615	Phytochemistry	2	0	2	50	50	100
PC 616	Industrial Training/Project/Practical	--	18	18	500	200	700
Total		**12**	**18**	**30**	**750**	**450**	**1200**

(1.2)

Model paper for B.Voc Pharmaceutical Chemistry Internal Examination

Hemchandracharya North Gujarat University, Patan
Bachelor of Vocation
Pharmaceutical Chemistry Semester I
Internal Examination, November 2015
Subject:

Time: 2 hrs Date: Marks: 60

Q.1 Answer any 12 questions. Each question carries 1 mark [12*1=12]

1. MCQ
2. Fill in the blank
3. Definitions
4. Match of the following
5. MCQ
6. Fill in the blank
7. True /False
8. Match of the following
9. Fill in the blank
10. Definitions
11. Reasons of True /False
12. MCQ
13. True /False

Q.2 Answer any 5 questions. Each question carries 04 marks [5*4=20]

1.
2.
3.
4.
5.
6.

Q.3 Answer any 4 questions. Each question carries 07 marks [4*7=28]

1.
2.
3.
4.
5.

(13)

MODEL PAPER

Hemchandracharya North Gujarat University,Patan
Bachelor of Vocation
'Pharmaceutical Chemistry' Semester - I
END TERM Examination, November, 2014
Subject:

Time: 2 hrs **Date** **Maximum marks: 50**

Q.1 Answer any 9 questions. Each question carries 1 mark **(9*1=9**
Marks)
(OBJECTIVEQUESTIONS)

1. a) b) c) d)
2. Fill in the blank.
3. Short Questions / Definitions.
4. Match the following.
5. Assertion / Reason of
6. a) b) c) d)
7. Fill in the blank.
8. Short Questions / Definitions.
9. Match the following.
10. Assertion / Reason of True / False.

Q. 2 Answer any 5 questions. Each question carries 4 marks **(5*4=20**
Marks)
(SHORT QUESTIONS)

1.
2.
3.
4.
5.

Q.3 Answer any 3 question. The question carries 07 marks **(3*7=21**
Marks)
(DESCRIPTIVE QUESTIONS)

1.
2.
3.
4.

Semester III

Course Code	Course Title	Credit		Total	Marks		Total
		Theory	Prac./Field	Theory	Internal	External	
PC 311	Advanced Organic Chemistry	3	0	3	50	50	100
PC 312	Advanced Analytical Chemistry-I	3	0	3	50	50	100
PC 313	Cell Biology	2	0	2	50	50	100
PC 314	Indian Drugs Regulatory Guidelines	2	0	2	50	50	100
PC 315	Pharmaceutical Inorganic Chemistry	2	0	2	50	50	100
PC 316	Practical	--	18	--	500	200	700
Total		**12**	**18**	**30**	**750**	**450**	**1200**

PC-311 Advanced of Organic Chemistry

SUBJECT CODE: PC 311

RATIONALE: Majority of the drugs used are organic in nature and therefore understanding the basics of organic chemistry, naming these complex chemical structures, understanding the chemical and physical properties of the common groups of compounds and also doing synthesis of these compounds becomes very important in understanding drug properties.

COURSE OBJECTIVES :

1. To learn the simple organic chemical reactions.
2. To learn fundamentals of symmetry and metal complexes.
3. To identify organic compounds by testing their physical and chemical properties.

LEARNING OUTCOMES :

The student should be able to:

1. Narrate physical and chemical properties of different compounds representing different functional group.
2. Write chemical reactions depicting synthesis and chemical properties of these organic compounds.
3. Synthesis some organic compounds.
4. Identify unknown organic compounds by conducting different physical and chemical

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 311	Advanced Organic	3	3	50	50	100

Unit-1

Structure of molecule

Atomic Orbitals, Hybridization, Sigma and Pi bonds, Intermolecular forces and related properties, Conjugation, Bond length and bond energies, Polarity of Bonds and Molecules.

Unit-2

Electro availability effects

Inductive effects, Resonance effects, Hyper conjugation, Steric effects, Application of these factors on the strength of acids and bases Bond length, Tautomerism.

Unit-3

Symmetry

Conservation of orbital symmetry and rules, electrocyclic, cycloaddition and sigmatropic reactions; neighbouring group effects, catalysis by transition metal complexes.

Unit-4

Nucleophillic and electrophilic aromatic reactions

Relation between Kinetics and mechanism of SN_1 and SN_2 reactions, sterochemical Implications

Factors affecting Nucleophilic substitution reactions:-

a. Effect of Solvent
b. Effect of Structure
c. Effect of Nucleophile
d. Effect of leaving group
e. Application of these in preparation and reactions of alkyl halides, alcohols
f. Nucleophilic substitutions at aryl carbon atom

Elimination reactions

a. Elimination reaction & Factors affecting it
b. E_1, E_2 and E_1 (cb)Mechanism.
c. Orientation in E1 and E2 reactions (Saytzaff and Hoffmann elimination).
d. Elimination versus substitution.

Recommended Books for the syllabi are:

1. Morrison & Boyd, Organic Chemistry, Prentice-Hall, 6th, 2001.
2. Advanced Organic Chemistry: Reaction, Mechanism and Structure by Jerry March 4th edition, A Wiley-Interscience Publication.
3. Organic Chemistry by I. A. Finar.

Reference Books:

1. Miller J, Aromatic Nucleophilic Substitution, Elsevier, 7th, 1968.
2. Furniss, Vogel's Textbook of Practical Organic Chemistry, Pearson education, 5th, 2004.
3. Norman R, Principles of Organic Synthesis, Wily, 4th, 1981.
4. Sykes P, A Guide to Mechanism in Organic Chemistry, Longman, 3rd, 1981.
5. Barton D, Compressive Organic Chemistry, Pergamon, vol.6, 1979.

PC-312 Advanced Analytical Chemistry-I

SUBJECT CODE: PC 312

RATIONALE: Measuring Drug purity is a primary requirement to ensure the quality of drugs. Quantifying the purity of compound can be done by different techniques. Some of the most commonly used techniques will be taught in this subject. This will make the student capable to work in a quality control department of the pharmaceutical industry

COURSE OBJECTIVES :

1. To make students familiar with the principles of analytical chemistry (Instrumental methods) and its application in pharmaceutical chemistry.
2. To provide the hands□on experience by actually conducting these assays in the lab.

LEARNING OUTCOMES :

The student should be able to:

1. Narrate the principles of methods and instruments used in assay of various drugs and chemicals.
2. Conduct assays of some drugs using these methods and instruments.
3. Describe basic principles and guidelines pertaining to quality assurance of drugs.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 312	Advanced Analytical Chemistry-I	3	3	50	50	100

Unit-1

Extraction techniques

Simple extraction, multiple extractions, separation of drugs in multicomponent system. Effect of pH on extractability of drugs, continuous extractions.

Unit-2

Chromatography

Classification, theories, retention mechanism, separation efficiency, methodology and pharmacopoeial applications of column, paper and thin layer chromatography.

Unit-3

Electroanalytical methods: Basics of electro analytical methods

A. Potentio and pH metric methods

Standard reduction potentials, various electrodes, electrodes and cell potential, applications of potentiometry and pH metry.

B. Conductometry:

Conductance, factors affecting conductance, Kohlrausch law, conductivity cells, applications

Unit-4

Miscellaneous Method

Kjehldahl's method, Karl Fischer Titration

Recommended Books for the syllabi are:

1. Gary D. Christian, Analytical chemistry, John Wiley & Sons N.Y., 5th Ed.,1994.
2. J.A. Dean, Analytical chemistry handbook, ,McGraw hill Inc., 1st Ed.,1995.
3. Principles of Instrumental Analysis, Skoog, Hollar and Nieman, Harcourt College Publishers, Philadelphia, 1998.
4. P.L. Soni, O.P. Dharmarha, U.N. Dash, Textbook of Physical Chemistry, 22nd Edition, Sultan Chand and Sons, New Delhi, 2001.

Reference Books:

1. J.H.Kemedy, Analytical chemistry: principles, W.B.Saunder publishing, 2nd Ed., 1990
2. Indian Pharmacopoeia2007, Volume–I,II and III.
3. Practical Pharm. Chemistry, Vol. B - Backett, The athlone Press of University of London.
4. Quantitative chemical analysis - Vogel A.I, Pearson Education., 5th Edition, 1996.
5. Instrumental method of chemical analysis by Gurdeep Chatwal, Himalaya publishing house, 2005.
6. Quantitative analysis of drugs in pharmaceutical formulations by P.D.Sethi CBS Publishers N.D.3rd Edition, 1997.
7. A Textbook of pharmaceutical analysis by Kenneth A. Connors. Jon Wiley and sons, 3rd Edition, 1982.
8. Textbook of Pharmaceutical Analysis - J. W. Munson, Marcel Dekker Inc., New York.
9. Stahl E.; Thin Layer Chromatography, A Laboratory Handbook, 2nd Edn, Springer-Verlag New York, LLC; 1969.

PC-313 Cell Biology

SUBJECT CODE : PC 313

RATIONALE : Understanding the biology of cell is fundamentally required for studying the effect of drugs on human body. The course will enable student to learn the basic cell biology system. Also the structure of DNA/RNA, its modification & transcription will be taught.

COURSE OBJECTIVES

1. To learn the structure and function of DNA/RNA.
2. To learn the basic cell biology processes occurring within the human body and factors regulating the same.

LEARNING OUTCOMES :

The student should be able to:

1. Describe the structure and functions of cell, cell size, cell wall etc.
2. Narrate the structure of prokaryotic and eukaryotic cell.
3. Describe the basic principles of cell systems & cell divisions.
4. Classify the different enzymes.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 313	Cell Biology	2	2	50	50	100

Unit-1

- Cell theory: cell size and diversity, Structure of prokaryotic and eukaryotic cell.
- Plasma membrane, cell wall, mitochondria, chloroplast, nucleus, endosomes, peroxisomes, ribosomes their organization and function, transport of nutrients ions and drug substances across membranes, ion channels, endocytosis, pinocytosis, potosis, diffusion and active transport systems, cellular energy transduction role of mitochondria and chloroplast systems.

Unit-2

Cell cycle and cell division

Meiosis, mitosis, molecular events in growth and cell death, cell receptors: role in signal transduction and cellular response, cytoskeleton: microtubules and their role in cell structural organization; intracellular trafficking and cell motility.

Unit-3

DNA / RNA structure

Organization of genetic material, replication, DNA repair, chromosomal morphology (condensation/decondensation) transcription, RNA polymerase, transcription factors, regulatory element, mechanism of transcription regulation, gene splicing, post transcriptional RNA modifications, 5'cap formation, transcription formation, 3'endo polyadenylation, splicing, mRNA its stability and transportation, translation, prokaryotic and eukaryotic translation machinery, initiation; elongation, regulation; co-post translational modification of protein.

Recommended Books for the syllabi are:

1. Molecular Biology by J.M. Walker & E.B. Gingold.
2. Molecular & Cell Biology by B. Albens.
3. Molecular Cell Biology by L. Lodish.

Reference Books:

1. Molecular Cell Biology by David Freifelder.
2. Molecular & Cell Biology by Sheelar & Bianchi.
3. Cell & Molecular Biology by De Robertis & Robertis Jr. (VIII Edition).
4. Cell Biology by David E. Sadava.
5. Cell Biology, Genetics, Molecular Biology, Evoluation & Ecology by P.S. Varma. & V.K. Agrawal.
6. Cell Biology by Satyesh Chandra Raoy, Kalyan.

PC-314 Indian Drugs Regulatory Guidelines

SUBJECT CODE: PC 314

RATIONALE : Sincerely work in the laboratory by different techniques to get the maximum output. Some of the most common instruction and care will be taught in this subject. This will make the student capable to work in a quality control department of the pharmaceutical industry.

COURSE OBJECTIVES

1. To make students familiar with basic principle of Laboratory & Research practice as well as new drug development in human

LEARNING OUTCOMES

The student should be able to:

1. Correctly working in the laboratory.
2. Design the SOP's, STP's, COA's & MOA's.
3. How to register new drug molecule.
4. Learn basic principles of pharmacopeia and ICH guidelines.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 314	Indian Drugs Regulatory Guidelines	2	2	50	50	100

Unit-1

Good Laboratory Practice, Standard Operating Procedure, Standard Testing Procedure, Certificate of Analysis, Method of Analysis, Good Receipt Note

Unit-2

Approval of new drugs

Investigational New Drug (IND) submission, format & content of IND, content of Investigator Brochure, general consideration of New Drug Approval (NDA), specific requirements, content & format of NDA, manufacturing control requirement of NDA.

Unit-3

- cGMP, GLP, ISO 9000, TQM, ICH guidelines for method validation.
- Occupational Health and Hazards, Safety at Workplace, Accident Prevention Techniques, Safety Management System, list of hazardous chemicals and handling of toxic and hazardous chemicals, acids, ether &etc.

Recommended Books for the syllabi are:

1. Gary D. Christian, Analytical chemistry, John Wiley & Sons N.Y., 5th Ed.,1994.
2. Indian Pharmacopoeia2007, Volume–I,II and III.
3. International Conference on Harmonisation of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonised Tripartite Guideline. Guideline for Good Laboratory Practice.

Reference Books:

1. J.A. Dean, Analytical chemistry handbook, McGraw hill Inc., 1st Ed.,1995.
2. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi.
3. Goodman & Gilman: JG Hardman, LE Limbard, 10th Edn. McGraw Hill Publications, 2001.
4. Central Drugs Standard Control Organization. Good Clinical Practices-Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.

PC-315 Pharmaceutical Inorganic Chemistry

SUBJECT CODE : PC 315

RATIONALE : Some of the inorganic compounds are extensively used either as drugs or excipients. The subject will provide preparation, properties, uses of these compounds. Also some simple methods for determining purity and quality of these compounds will be taught.

COURSE OBJECTIVES :

1. To learn the structure, preparation, properties and medicinal uses of various inorganic compounds.
2. To learn the methods used to determine purity and quality of inorganic medicinal compounds.

LEARNING OUTCOMES :

The student should be able to:

1. Describe the method of preparation, assay principle for testing purity, official methods to measure the quality and medicinal uses of important inorganic compounds.
2. Refer the Pharmacopeia (monographs and appendices) for the drugs they study.
3. Prepare some standard reagents used in testing purity and quality of inorganic compounds.
4. Conduct limit tests for heavy metals, iron, arsenic, lead, chloride, sulphates as per pharmacopeia.
5. Conduct quantitative tests to identify inorganic mixtures

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 315	Pharmaceutical Inorganic Chemistry	2	2	50	50	100

Unit-1

Diagnostic drugs, pharmaceutical necessities –preservatives, complexation and chelation - application in pharmacy, sources of impurities and their control, limit test for iron, arsenic, lead, heavy metals, chloride and sulphate; Gastrointestinal agents(Acidifying agents: dilute hydrochloric acid; Antacids: sodium bicarbonate, aluminium hydroxide gel, aluminium phosphate; Saline cathartics: sodium potassium tartrate and magnesium sulphate).

Unit-2

An outline of methods of preparation, uses, sources of impurities, tests of purity and identification and special tests, if any, of the following classes of inorganic pharmaceuticals included in IP 96, gases and vapours –inhalants(oxygen),anaesthetics(nitrous oxide), topical agents-protective (calamine, titanium dioxide, talc, kaolin), astringent (zinc oxide, zinc sulphate) and anti-infective (boric acid, H_2O_2, iodine, povidone iodine, potassium permanganate, silver nitrate.).

Unit-3

Pharmaceutical aids and necessities

A. Acids and bases-acid base theory ,specification of acidity and basicity, official inorganic acid(boric acid HCl, HNO_3, H_3PO_4), nonofficial inorganic acids(H_2SO_4), official inorganic bases(strong ammonia solution, calcium hydroxide, KOH, Na_2CO_3,NaOH,soda lime).

B. Buffers-theory and mechanism, pharmaceutical buffer selection, pharmaceutical buffer system, preparation of pharmaceutical buffer.

C. Antioxidant-theory, the selection of antioxidants, official antioxidants (hypophosphorous acid, sodium bisulphite, sodium thiosulphate, sodium nitrite, nitrogen).

D. Pharmaceutical accepted glass-chemistry of glass, types of test employed for glass.

E. Waters: official water (water, purified water, water for injection, bacteriostatic water for injection, sterile water for injection)

Recommended Books for the syllabi are:

1. G.R. Chatwal, Pharmaceutical Chemistry-Inorganic, Volume – I, 2nd Edition, Himalaya Publishing House, Mumbai, 2005.
2. G. Svehla, Vogel's Qualitative Analysis, 6th Edition, Orient Longman Pvt. Ltd, New Delhi, 1994.
3. Dr. A.V. Kasture, Dr. S.G. Wadodkar, Pharmaceutical Chemistry – I, 1st Edition, Nirali Prakashan, Pune, 1993.
4. A.H. Backett, J.B. Stenlake, Practical Pharmaceutical Chemistry, First Indian Edition, CBS Publishers, Delhi, 1987.Page 13 of 114.

Reference Books:

1. The Indian Pharmacopoeia 2007, Volume-I,II & III, Conteoller of Publication, 2007.
2. J.H. Block, E.R. Rocne, T.O. Soinr, C.O. Wilson, Inorganic Medicinal and Pharmaceutical Chemistry, First Indian Reprint, Varghese Publishing House, 1986.
3. N.M. Shah, Practical Chemistry, 2nd Edition Reprint, Eton Press Pvt. Ltd., Bombay, 1967.
4. H.D. Gehani, S.M. Parekh, R.V. Bhagwat, Inorganic Chemistry, 3rd Edition, A.R. Sheth and Co., Educational Publishers, Bombay, 1965.

5. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd Edition, Vallabh Prakashan, Delhi, 1999.
6. Dr. K.G. Bothara, Inorganic Pharmaceutical Chemistry, 1st Edition, Nirali Prakashan, Pune, 1994.
7. N.C. Chaudhary, N.K. Gurbani, Pharmaceutical Chemistry – I, 1st Edition, Vallabh Prakashan, Delhi, 1995.
8. V.V. Nadkarni, A.N. Kothare, P.S. Fernsndes, Semimicro Qualitative Analysis, 2nd Edition, Poular Prakashan, 1997.
9. T.O. Soine, C.O. Wilson, Roger's Inorganic Pharmaceutical Chemistry, 8th Edition, Lea and Febiger, USA, 1967.
10. A.G. Sharpe, Inorganic Chemistry, 3rd Edition, ELBS with Longman, UK, 1992.
11. M.S. Sethi, P.S. Raghawan, Concepts and Problems in Inorganic Chemistry, 1st Edition, Discovery Publishihng House, New Delhi, 1998.
12. Bertini, Gray, Lippard, Velentine, Bioinorganic Chemistry, 1st Edition, Viva Books Pvt. Ltd., New Delhi, 1998.

PC-316: Practical

SUB CODE	TITLE OF SUBJECT	Credit	EVALUATION SCHEME		Total Marks
			Continuous Evolution	End Term Evolution	
PC 316	Practical	18	500	200	700

Practical:

1. Preparation of Boric acid or calcium Lactate.
2. Qualitative analysis of given inorganic mixtures. (cations + Anions) (at least 5 mixtures).
3. To perform the limit test for chloride and sulfate.
4. To perform the limit test for Iron and lead.
5. To perform the assay of hydrogen peroxide.
6. To perform the assay of Zinc oxide.
7. To perform the assay of calcium gluconate.
8. To perform the assay of aspirin.
9. To demonstrate Karl Fischer apparatus
10. To find out the concentration of given acid solution by potentiometer.
11. To determine the content of sulfamethizole (from tablets) by potentiometer.
12. To find out the concentration of given acid solution by pH meter.
13. To determine the dissociation constant of given acetic acid solution by pH metry.
14. To find out the concentration of given acid solution by using conductometer.
15. Introduction and detailed demonstration to various synthetic techniques and apparatus used in that technique..
16. Heating and cooling methods, distillation, reaction work-up, filtration,extraction, purification, identification.
17. Introduction to the use of stereo models.
18. Introduction to instrumental technique (3-4).
19. To study and demonstration of Paper Chromatography.
20. To study and demonstration of TLC.
21. To perform the paper chromatography of given sample.
22. To perform the TLC of given sample.
23. To estimate nitrogen content by kjeldahl's method.
24. To validate the different apparatus and instrument.
25. To study nitration reaction by synthesis of drug.
26. To study bromination reaction by synthesis of drug.
27. To study friedel craft alkylation reaction by synthesis of drug.
28. To studyfriedel craft acylation reaction by synthesis of drug.
29. Determination of bulk density, tapped density, Carr's Index and Hausner's ratio of given powder samples
30. Determination of angle of repose of given powder samples
31. Determination of concentration of given samples using colorimetry.

Curriculum for Semester IV

Semester IV

Course Code	Course Title	Credit		Total	Marks		Total
		Theory	Prac./Field		Internal	External	
PC 411	Medicinal Chemistry –I	3	0	3	50	50	100
PC 412	Microbiology	2	0	2	50	50	100
PC 413	Advanced Analytical Chemistry-II	3	0	3	50	50	100
PC 414	Pharmaceutics- Unit operation	2	0	2	50	50	100
PC 415	Pharmacy Practice	2	0	2	50	50	100
PC 416	Practical	--	18	18	500	200	700
Total		**12**	**18**	**30**	**750**	**450**	**1200**

PC-411 Medicinal Chemistry –I

SUBJECT CODE: PC 411

RATIONALE: Basic chemistry learnt till previous semester is now getting extended to medicinal chemistry where the student learns the chemistry of complex drug molecules and how a chemical structure and alter the body functions.

COURSE OBJECTIVES

To learn the structure, Structure activity relationship, physicochemical properties and drug design and docking of drug.

LEARNING OUTCOMES

The student should be able to:

1. Draw correct chemical structure of drugs.
2. Give scientific name of drugs.
3. Narrate Physicochemical properties and Structure activity relationship.
4. To know about drug design and molecular modeling.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 411	Medicinal Chemistry –I	3	3	50	50	100

Unit-1

Drug design:

Analogues and prodrug concept, Concept of lead, Rational approach to drug design, Overview of drug design and development, Tailoring of drug.

Unit-2

Physiochemical properties of drug molecules influencing biological activity:

Physical properties,Meyer-overton and meyer-hemmi theory,Fergusion theory,vanderwaal's constant, steric factors, Factors governing ability of drugs to reach active site, Stereochemistry and drug action,bioisosterism.

Unit-3

Molecular modeling and drug design:

De novo Drug Design,Molecular modeling (MM),Computer Aided Drug Design (CADD),Methods of Lead Discovery,Identification and Optimization of Lead, Docking study indroduction.

Unit-4

QSAR

Lipophilic, electronic and stearic parameters, Hansch Linear Free Energy Relationship (LFER) model of QSAR, Free Wilson Mathematical Model of QSAR.

Recommended Books for the syllabi are:

1. Wilson and Giswold's Textbook of Organic, Medicinal and Pharmaceutical Chemistry,J. N. Delagado and W. A. R. Remers, Eds, J. Lipponcott Co. Philadephia.
2. Principles of Medicinal Chemistry by W. C. Foye,, Lea & Febiger, Philadelphia.
3. Burger's Medicinal Chemistry, H. E. Wolff, Ed. John Wiley & Sons, New York Oxford University Press, Oxford.
4. Singh and Kapoor "A Text Book of Pharmaceutical and Medicinal Chemistry" Vallabh Prakashan, New Delhi.

Reference Books:

1. Strategies for Organic Drug Synthesis & Design by Daniel Lednicer, John Wiley & sons, USA.
2. Organic Chemistry by L. Finar, Vol. I & II, ELBS/ Longman, London.
3. Kar, A., Medicinal Chemistry, New Age International Publishers, New Delhi, 2007.
4. Ladu, B. N., Mandel H.G. & E.L.Way, Fundamentals of Drug Metabolism & Disposition,William & Wilkins Co., Baltimore.
5. Taylor, J. B and Triggle, D. J., Comprehensive Medicinal Chemistry II, Vol. 1-8, Quantitative Drug Design, Elsevier Ltd., 2007.

PC-412 Microbiology

SUBJECT CODE: PC 412

RATIONALE: Microbiology is an exciting discipline with far-reaching impacts in human health and disease. This course will focus on the study of bacteria, viruses, and fungi and their interrelationship with human disease development. There will be emphasis on microbial structure, growth, metabolism, genetics and microbial diversity. Laboratory focuses on microbial identification, handling, staining and growth. During the first half of the course we will cover the basic principles of microbiology including microbial growth and metabolism, reproduction, and microbial diversity. In the second half of the course we will draw on the basic principles learned in the first half of the semester to understand microbiology as it relates to human health, and human disease.

COURSE OBJECTIVES

1. This course will cover topics in the history of microbial morphology and physiology, bacterial metabolism, genetics, and the classification of microorganisms.
2. This course will increase your awareness and appreciation for microscopic organisms in your environment and their relationships to humans in health and disease.
3. This course will also provide you with tools for a better understanding of microbial pathogenesis, means of control and treatment.

LEARNING OUTCOMES

The student should be able to:

1. Understand how microorganisms survive where they do, how they are related, and how they interact with us.
2. Have a solid grasp of the scope of the microbial world and its role in human disease.
3. How to control bacterial growth□ use of chemical and physical agents to control microbe propagation How to provide a microbe□free environment for the health professional.
4. Understand the rationale behind the use of chemicals to control bacterial propagation (anti-microbial agents).
5. How microorganisms relates with us causing disease.
6. Summarize mechanisms of animal defenses to infection, including primary defenses, innate immunity, and acquired immunity.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 412	Microbiology	2	2	50	50	100

Unit-1

Scope and history of microbiology, types of microorganism, Classification of microbes, Actinomycetes, bacteria, rickettsiae, spirochetes and viruses, Identification of microbes: stain and types of staining techniques, electron microscopy, Nutrition, cultivation, isolation and identification of bacteria, actinomycetes, fungi, viruses.

Unit-2

Control of microbes by physical and chemical methods

A. Disinfection, factors influencing disinfectants, dynamics of disinfection, disinfectants, antiseptics and their evaluation.
B. Sterilization: different methods, validation of sterilization methods and equipments, Sterlity testing of pharmaceutical products.
C. Clean area classification
D. Validation of aseptic room

Unit-3

preservative efficacy, Microbial assay of antibiotics and vitamin B12, Immunology and immunological preparations: principles, antigens and haptens, immune system, cellular and humoral immunity, immunological tolerance, antigen-antibody reactions and their applications, Hypersenstivity, active and passive immunization products, their preparation, standardization and storage

Recommended Books for the syllabi are:

1. G. Gunnz & S.J. Carter "Cooper & Gunn's Tutorial Pharmacy", 6th ed., Pitman Medical Publishing Co., London 1972.
2. W.B. Hugo and A.D. Russell "Pharmaceutical Microbiology", 4th ed., Blackwell Scientific Publication, Oxford, 1987.
3. "Microbiology"- Davis, Dulbecco, Eisen.

Reference Books:

1. "Remington's Pharmaceutical Sciences" Gennaro A.R. Ed., 18th ed., Mack Publishing Co., Easton, Pa, USA, 1990.
2. L.M. Prescott, G.P. Jarly, D.A. Klein, "Microbiology" 2nd, ed. Wm. C. Brown Publishers, Oxford, 1993.
3. S.P. Vyas, V.K. Dixit,"Pharmaceutical Biotechnology"1st ed. CBS Publishers & Distributors, New Delhi, 1998.
4. N.K. Jain,"Pharmaceutical Microbiology" Vallabh Prakashan, Delhi.
5. K. Kieslich, Ed. "Biotechnology" vol. VI a, Verlag Chamie, Switzerland, 1984.
6. G. Reeves "Lecture Notes on Immunology" Blackwell Scientific Publication, Oxford, 1987.
7. Laboratory Manual of Bacteriology- Salle.

PC-413 Advanced Analytical Chemistry-II

SUBJECT CODE : PC 413

RATIONALE: This subject discusses methodology, instrumentation, and applications of chromatographic techniques to estimate drug substances and drug products.

COURSE OBJECTIVES

1. Understand basic principles of instrumental analysis of drugs and drug products.
2. Know basic principles of advance chromatographic analysis.
3. Know theoretical interpretation of the analytical results.

LEARNING OUTCOMES

The student should be able to:

1. Make choice of correct analytical method for given drug.
2. Aware of pharmacopoeial methods of analysis and standards for drugs.
3. Conduct analytical experiments of drug products by handling instruments.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 413	Advanced Analytical Chemistry-II	3	3	50	50	100

Unit-1

HPLC

High Performance Liquid Chromatography(HPLC): introduction, theory - migration equation, theoretical plate, columns and stationary phases, measurement of column performance and its optimization, instruments for liquid chromatography including column packing for various types of chromatography, Classification and Principle of HPLC, mobile phase characteristics for normal and reversed phases, polarity and selectivity of the solvents, Instrumentation (including significance of guard column), scope and applications.

Unit-2

HPTLC

Introduction, HPTLC, Quantitation - scraping and elution, visual comparison, area management, densitometry and thermal methods, applications and recent advancement.

Unit-3

GC

Introduction, principles of Gas-Chromatography, instrumentation, columns and stationary phases, qualitative and quantitative applications in pharmaceuticals.

Unit-4

Analytical Method Development & Validation protocol preparation

Method Optimization, Accuracy, Precision, Linearity, Specificity, System suitability, Robustness.

Recommended Books for the syllabi are:

1. Principles of Instrumental Analysis, Skoog, Hollar and Nieman, Saunders college Publishers, Philadelphia.
2. Munson JW. High performance liquid chromatography: Theory, instrumentation, and pharmaceutical applications. In; Pharmaceutical analysis modern methods part B, New York, Marcel Dekker.
3. Pharmacopoeia: USP, B.P., I.P.

Reference Books:

1. Instrumental Methods of Analysis, Willard, Merritt, Dean and Settle, CBS publishers and Distributers, Delhi.
2. Introduction to High Performance Liquid chromatography, R. J. Hamilton, Chapman and hall, London.
3. Instrumental Methods of Chemical Analysis, BK Sharma, Goel Publication House, Meerut, Second Edition- 2001 India.
4. Instrumental Methods of Chemical Analysis, 3rd ed, G. W. Ewing, McGraw Hill Book Co, NY-1969.
5. Introduction of Instrumental Analysis, Robert Braun, McGraw-Hill: New York.

PC-414 Pharmaceutics-Unit operation

SUBJECT CODE: PC 414

RATIONALE : The subject is meant for exposing the student to different unit operations. Routes of drug administration and their merits and demerits. Also the student will be provided knowledge of fundamental physical properties of compounds useful in manufacturing of drug formulations. The in depth understanding of some of the important basic processes used in Industry for the formulations will also be taught.

COURSE OBJECTIVES :

1. To study unit operations like size reduction, size separation, mixing and crystallization. These Unit operations have applications in manufacturing and compounding of dosage forms. Some unit operations also have applications in manufacturing of bulk drugs.
2. It is also intended to make students familiar with process control systems, industrial hazards and safety precautions.

LEARNING OUTCOMES :

The student should be able to:

1. To develop skills with respect to applications of unit operations like size reduction, size separation, mixing and crystallization, compounding/preparation of pharmaceutical products at laboratory level.
2. To understand construction and working of equipments used for unit operation.
3. To understand applications of these unit operations in manufacturing of drugs/dosage forms.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 414	Pharmaceutics-Unit operation	2	2	50	50	100

Unit-1

Size Reduction:

Objectives, theory of size reduction, energy requirement in size reduction, factors influencing size reduction, limit of size reduction, wet and dry milling, application.

- Selection of size reduction equipment
- Study of various mills including ball mill, hammer mill, fluid energy mill, colloid mill, cutter mill
- Introduction to methods of generating nanoparticles

Unit-2

Size Separation:

- Principles of size separation, screens- types, Pharmacopoeial standards, screening methods,
- Screening equipments including shaking and vibrating screens, gyratory screens, sedimentation tank, elutriation and cyclone type separators.
- Application of size separation in pharmacy.

Unit-3

Mixing:

- Theory of mixing, mixing mechanisms, types of mixtures.
- Solid - solid, solid - liquid and liquid - liquid mixing equipment.
- Semisolid mixing.
- Importance of content uniformity in solid dosage forms.

Crystallization:

- Objectives, crystal lattice, types of crystal, crystal form, size and habit, formation of crystals, supersaturation theory, factors affecting crystallization process, crystal growth.
- Study of various types of crystallizers: Swenson walker, tanks, circulating magma, vacuum and crystal cooling crystallizer.
- Spherical crystallization and its application in pharmacy.
- Brief introduction of co-crystals.

Recommended Books for the syllabi are:

1. Perry's Chemical Engineer's Handbook - Robert H Perry, Green D.W., Maloney J.O., McGraw – Hill Inc., New York.
2. Tutorial Pharmacy by Cooper & Gunn, ed. S. J. Carter, CBS Publishers & Distributors, Delhi.
3. Pharmaceutics The Science of Dosage form Design, Aulton M E, Churchill Livingstone, London.

Reference Books:

1. The Theory & Practice of Industrial Pharmacy – Lachman L., Lieberman H.A. & Kanjig J.L., Varghese Publishing House, Bombay.
2. Alfonso G. Remington: The Science & Practice of Pharmacy. Vol. I & II. Lippincott, Williams & Wilkins Philadelphia.
3. Introduction to Chemical Engineering, W. L. Badger and J. T. Banchero, Tata McGraw-Hill Publishing Company Limited, New Delhi.
4. Encyclopedia of Pharmaceutical Technology, James Swarbrick, Informa Healthcare, USA.
5. Principles and Practice of Automatic Process Control, C. A. Smith and A. Corripio, John Willey & Sons, Inc., USA.
6. Industrial Hazards and Plant Safety, Sanjoy Banerjee, Taylor and Francis, New York.

PC-415 Pharmacy Practice

SUBJECT CODE : PC 415

RATIONALE : The aim of this course is to familiarise participants with some of the issues of formulation and stability in compounding extemporaneous preparations and safe systems of work for extemporaneous dispensing. Patient specific issues such as nasogastric administration and patient information leaflets for extemps are also covered.

COURSE OBJECTIVES

1. To learn the structure, preparation, properties and medicinal uses of various inorganic compounds.
2. To learn the methods used to determine purity and quality of inorganic medicinal compounds.

LEARNING OUTCOMES

The student should be able to:

1. Understand some of the issues of pharmaceutical formulation with regard to drug stability and be able to identify and discuss what the roles of various excipients in a formulation are.
2. Understand the factors affecting the choice of preservative in a formulation and its effect on in use of shelf life.
3. List the basic principles for establishing a safe system of work for extemporaneous dispensing.
4. Understand some of the Physical and Clinical problems associated with administration of medicines by enteral feeding tubes.
5. Define a safe system for drug administration by enteral feeding tube.
6. Draw up an extemporaneous dispensing worksheet and devise a generic patient information leaflet for extemporaneous products.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 415	Pharmacy Practice	2	2	50	50	100

Unit-1

- **Prescription:** Definition, parts, handling, sources of errors in prescriptions, knowledge of latin terms commonly used in prescription writing and their translation into English. Modern concepts of dispensing pharmacy.
- **Compounding of medication:** Powders, Tablets, Capsules, Tablet triturates, Pills, Lozenges, Ointments, Creams, Pastes, Jellies, Suppositories, Suspensions, Emulsions, Mixtures, Sprays, Inhalations, Paints. Labeling of dispensed products.
- **Incompatibility:** Physical, chemical and therapeutic incompatibilities and their corrections.

Unit-2

- **Community pharmacy:**

Introduction and management. Community Pharmacy Organization and structure of retail and wholesale drug store- types of drug stores and design - Legal requirements for establishment, maintenance of drug store, Dispensing of proprietary products, Maintenance of records of retail and whole sale

- **Inventory Control in community Pharmacy:**

Definition, various methods of inventory control. ABC, VED, EOQ, Lead time, safety, stock.

Unit-3

- **Pharmaceutical care:**

Definition and principles of pharmaceutical care. Emergency treatment in shock, snake-bite, burns, poisoning, heart diseases, fractures, resuscitation methods. Elements of minor surgery and dressings.

- **Health education:**

WHO definition, health promotion care of child, pregnant & breast feeding women and geriatric patient, role of pharmacist in family planning. Prevention of communicable diseases i.e., tuberculosis, hepatitis, leprosy, AIDS, syphilis, gonorrhea.

Recommended Books for the syllabi are:

1. Hoover 's Dispensing of medication. Mack Publishing.
2. "Pharmaceutical Practice" By Diana M. Collett And Michale E. Aulton. Elbs Publishers.
3. "Dispensing For Pharmaceutical Students" By Cooper And Gunn By S.J.Carter, Cbs Publishers.

Reference Books:

1. Joseph Barnett Sprowls. Prescription Pharmacy.
2. S. J. Carter. Cooper and Gunn's Dispensing for Pharmaceutical Students: Carter. 11th edition. CBS Publishers.
3. N.K. Jain and S.N. Sharma. The Concise Pharmaceutical Dispensing. Vallabh Prakashan, Delhi.
4. N.K. Jain. Health Education and Community Pharmacy. CBS Publishers.
5. "Pharmaceutical Dosage Forms And Drug Delivery Systems" By Howard C. Ansel By Lippincott Williams & Wilkins.
6. "Remington: The Science And Practice Of Pharmacy", Mac Publishers.
7. "Drug And Cosmetics Act And Rules" By Vijay Malik.
8. "A Practical Guide To Pharmaceutical Care", Rovers John P. Ed. (*et.al.*), American Pharmaceutical Association.
9. "Current Dispensing Practices", Nanda Arun, Vallabh Prakashan.
10. "Pharmacy Practice For Technicians", Ballington Don A., New Age International Publication

PC-416: Practical

SUB CODE	TITLE OF SUBJECT	Credit	EVALUATION SCHEME		Total Marks
			Continuous Evolution	End Term Evolution	
PC 416	Practical	18	500	200	700

Practical:

1. To separate and identify the given organic binary mixture.(solid-solid) (Atleast 5-6 samples).
2. To study reaction monitoring by Thin Layer Chromatography (TLC).
3. To synthesize sulphanilamide from acetanilide. (Step 1).
4. To synthesize phthalimide from phthalic anhydride.
5. To synthesize anthranilic acid from phthalimide.
6. To synthesize N-phenyl anthranilic acid from o-chlorobenzoic acid
7. Data collection: Ideal slides of micro organisms. (Bacteria, virus, Spirochaets, Ricketssia, Fungi etc.).
8. Preparation of various growth media.
9. Identification of microbes by staining techniques.
10. To study the standards of tablets as per IP 96 Sums related to standards of tablets.
11. To perform weight variation tests as well as content of active ingredient test of given sample of the mefanamic acid tablet.
12. To Perform assay of calcium gluconate in given sample of calcium glucanate injection as per IP.
13. To Perform content of active ingredient test and weight variation for tablet of Metformin HCl.
14. To perform weight variation test and content of active ingredient test for given chloramphenicol capsule as per IP 96.
15. To demonstrate GC as analytical tool.
16. To demonstrate HPLC as analytical tool.
17. To demonstrate HPTLC as analytical technique.
18. To determine energy utilized by ball mill for size reduction process.
19. To determine particle size distribution of given sample of granules by sieving method.
20. To determine % yield of crystals in crystallization experiment under different conditions.
21. To produce crystals using different conditions of crystallization and to study the crystal habit.
22. To study the effect of speed and time on solid liquid mixing.
23. To determine the mixing efficiency of two immiscible liquid using variable speed propeller mixer.
24. To determine mixing index of a given powder mixture using double cone blender.
25. To determine the rate of mixing of solid in liquid using a magnetic stirrer at different speeds.
26. Demonstration of following instruments:
    a. Hammer mill
    b. Jaw crusher.
27. Demonstration of following instruments:
    a. Vibrating (Oscillating) Sifter.
    b. Double Cone Mixer
28. Demonstration of pyrogen test.
29. To study the effect of filter aid on sedimentation rate and to determine optimum concentration of filter aid.

30. To determine humidity and % humidity of air using wet bulb-dry bulb method
31. To determine humidity and % humidity of air using dew point method.
32. To isolate volatile oil of given drug using distillation method.
33. To determine % of volatile oil in given plant drug using clavenger's apparatus.
34. To determine mixing index for blending given powder using laboratory mixer.
35. To determine the percentage of acetic acid recovered from mixture of Benzene and Acetic acid using water as an extracting agent.
36. To determine the average particle size & to study particle size distribution using standard sieve method for given powder substance.
37. To study the efficiency of single and multiple extractions.

Curriculum for Semester V

Semester V

Course Code	Course Title	Credit		Total	Marks		Total
		Theory	Prac./Field		Internal	External	
PC 511	Medicinal Chemistry-II	3	0	3	50	50	100
PC 512	Advanced Analytical Chemistry-III	3	0	3	50	50	100
PC 513	Pharmacology -I	3	0	3	50	50	100
PC 514	Introduction to Drug Delivery Systems	3	0	3	50	50	100
PC 515	Practical	--	18	18	500	200	700
Total		**12**	**18**	**30**	**700**	**400**	**1100**

PC-511 Medicinal Chemistry –II

SUBJECT CODE: PC 511

RATIONALE: Basic chemistry learnt till previous semester is now getting extended to medicinal chemistry where the student learns the chemistry of complex drug molecules and how a chemical structure and alter the body functions.

COURSE OBJECTIVES

To learn the structure, Structure activity relationship, physicochemical properties and therapeutic uses of drugs belonging to various therapeutic classes.

LEARNING OUTCOMES

The student should be able to:

1. Draw correct chemical structure of drugs.
2. Give scientific name of drugs.
3. Narrate Physicochemical properties and Structure activity relationship.
4. To understand the mode of action of pharmaceutical drug.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 511	Medicinal Chemistry –II	3	3	50	50	100

Unit-1

a) **Steroids:** Introduction, Nomenclature, stereochemistry, simple reactions of cholesterol,Classification of steroids, Sterols, Sex hormones, Cardiac glycosides, Bile acids, sapogenins.

Unit-2

Chemical naming, structure activity relationship, physicochemical and steric aspects, mode of action and uses of.....

a) **General anaesthetic agents:** Introduction, medicinal aspects of anaesthetics, mode of action, gases and volatile liquid anaesthetics, intravenous anaesthetics of fixed

anaesthetics, toxicity of general anaesthetics (divinyl ether, ethyl chloride, cyclopropane, thiopentone sodium, ketamine)

b) **Local anaesthetic agents:** Introduction, SAR, benzoic acid derivatives, aminobenzoic acid derivatives, lidocaine derivatives, miscellaneous, toxicity, mode of action (benzocaine, procaine hydrochloride, mepivacaine, lidocaine, cinchocaine hydrochloride)

c) **Sedatives hypnotics:** Introduction, classification, SAR, barbiturates, amides and imides, alcohols, and their carbamate derivatives, aldehydes and their derivatives, mode of action, pharmacological properties and side effects (barbitone, phenobatnitone, cyclobarbitone, pentobarbitone sodium, thiopentone sodium) non barbiturates (official drugs),

d) **Anticonvulsants:** Introduction, classification of epilepsy, SAR, barbiturates (official drugs), hydantoins, oxazolidinediones, succinamides, miscellaneous dregs, phenytoin siodium, troxidone.

Unit-3

Chemical naming, structure activity relationship, physicochemical and steric aspects, mode of action and uses of……

a) **CNS stimulants:** CNS stimulants of natural origin, synthetic CNS stimulants (nikethamide, methylxanthines and modified methylxanthines (theophylline))

b) **Psychopharmacological agents:** Antipsychotics, phenothiazines (chlorpromazine, trifluperazine, butyrophenones, miscellaneous), antidepressants- TCA (amitriptyline), MAO inhibitors, atypical antidepressants, antianxiety drugs- meprobamate and related drugs, benzodianepines (diazepam)

c) **Hallucinogens**-hallucinogenic agents related to indoles, phenethylamines, cannabinoids.

d) **Diuretics:** Carbonic anhydrase inhibitors (acetazolamide and dichlorphenamide), Thiazides and related drugs (bendrofluazide), High ceiling diuretics, aldosterone antagonists, other potassium sparing diuretics, osmotic diuretics.

Unit-4

CVS agents:

Introduction, cardiac glycosides, SAR, mechanism of action, toxic effects, antihypertensive agents-introduction, etiology, ganglion blocking agents, antiadrenergic agents, drugs acting directly on smooth muscles, drugs acting in CNS (propranolol), antianginals and vasodilators- introduction, mechanism of smooth muscle vasodilatation, esters of nitrous and nitric acid, side effects(nitroglycetine), antiarryhthmic and antifibrillytic drugs classification of antiarrhythmic drugs, mechanism of action, side effects, antilipemic drugs. promethazine)

Recommended Books for the syllabi are:

1. Wilson and Giswold's Textbook of Organic, Medicinal and Pharmaceutical Chemistry,J. N. Delagado and W. A. R. Remers, Eds, J. Lipponcott Co. Philadephia.
2. Principles of Medicinal Chemistry by W. C. Foye,, Lea & Febiger, Philadelphia.
3. Burger's Medicinal Chemistry, H. E. Wolff, Ed. John Wiley & Sons, New York Oxford University Press, Oxford.
4. Singh and Kapoor "A Text Book of Pharmaceutical and Medicinal Chemistry" Vallabh Prakashan, New Delhi.

Reference Books:

1. Strategies for Organic Drug Synthesis & Design by Daniel Lednicer, John Wiley & sons, USA.

2. Organic Chemistry by L. Finar, Vol. I & II, ELBS/ Longman, London.
3. Kar, A., Medicinal Chemistry, New Age International Publishers, New Delhi, 2007.
4. Ladu, B. N., Mandel H.G. & E.L.Way, Fundamentals of Drug Metabolism & Disposition,William & Wilkins Co., Baltimore.
5. Taylor, J. B and Triggle, D. J., Comprehensive Medicinal Chemistry II, Vol. 1-8, Quantitative Drug Design, Elsevier Ltd., 2007.

PC-512 Advanced Analytical Chemistry-III

SUBJECT CODE: PC 512

RATIONALE: This subject discusses methodology, instrumentation, and applications of spectrophotometric and chromatographic techniques to estimate drug substances and drug products.

COURSE OBJECTIVES

1. Understand basic principles of instrumental analysis of drugs and drug products.
2. Know basic principles of spectrophotometry and chromatographic analysis.
3. Know theoretical interpretation of the analytical results.

LEARNING OUTCOMES

The student should be able to:

1. Make choice of correct analytical method for given drug.
2. Aware of pharmacopoeial methods of analysis and standards for drugs.
3. Conduct analytical experiments of drug products by handling instruments.
4. Interpret various spectra.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 512	Advanced Analytical Chemistry-III	3	3	50	50	100

Unit-1

Ultraviolet/Visible Molecular Absorption Spectroscopy:

Electromagnetic radiation - its properties and absorption by molecules, factors affecting absorption of radiation by molecules, Beer's Law and its deviations, Beer's & Lambert's Law instrumentation, sample handling techniques and pharmaceutical applications and recent advancement.

Unit-2

Infrared Spectrometry:

Introduction, instrumentation (components and their general working principles), sample handling, a brief

introduction to fourier transform infrared spectroscopy (FTIR) and ATR, applications and recent advancement, analytical shortcomings.

- Introduction to raman spectroscopy

Unit-3

Molecular Luminescence Spectrometry:

Theory of fluorescence and phosphorescence, factors affecting the intensity of chemiluminescence's, instrumentation and analytical applications and recent advancement.

Unit-4

Molecular Absorption Spectrometry:

Theory, aspects, basic instrumentation, elements of interpretation of spectra, and applications of Absorption Spectroscopy.

Recommended Books for the syllabi are:

1. Elementry Organic Spectroscopy, Y R Sharma.
2. Spectroscopy of Organic Compounds, P S Kalsi, New Age International Publishers.
3. G.R. Chatwaal, Analytical spectroscopy, 1st, Himalaya publishing house, Mumbai, 1996.
4. K.Bansal, Analytical spectroscopy, 1st Ed., Campus books, New Delhi, 2000.

Reference Books:

1. Applications of Absorption Spectroscopy of Organic compounds J. R. Dyer, Prentice Hall, London.
2. Organic Spectroscopy, W. Kemp, 3rd ed, ELBS publication, NY, 1991.
3. Spectroscopic identification of organic compounds. R.M. Silverstein, G.C. Bassler, T.C. Morrill Pub: John Wiley and Sons, NY.

PC-513 Pharmacology-I

SUBJECT CODE : PC 513

RATIONALE: This is one of the core subjects of Pharmacy field where student learns the biological effects of drugs. The subject has direct application to the profession as it teaches the student about how the drug produce effect, what effects are produced, what side effects are produced, where and when it should be used etc.

COURSE OBJECTIVES

1. To learn general concepts how the drug produces effect and what factors can contribute in producing the drug effects.
2. To learn the mechanism of action, pharmacological effects, pharmacokinetics, adverse effects,
   therapeutic application of various classes of drugs.

LEARNING OUTCOMES

The student should be able to:

1. Define and explain the various terminologies pertaining to the subject.
2. Explain the basic principles of Pharmacokinetics and pharmacodynamics.
3. Narrate the principals involved in measurement of drug effects.
4. Classify the drugs according to pharmacological classes.
5. Explain the mechanism of action, pharmacodynamics and pharmacokinetic effects of drugs, adverse effects, contraindications and therapeutic application of various classes of drugs.
6. Conduct some simple in vitro and in vivo experiments to demonstrate the pharmacological actions of the drugs.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 513	Pharmacology-I	3	3	50	50	100

Unit-1

- **General pharmacology:** Introduction to pharmacology, sources of drugs, dosage forms and routes of administration.
- **Pharmacodynamics :** General Principles of Drug Action, Molecular basis of drug Targets
- **Pharmacokinetics:** Absorption, Distribution, Metabolism and excretion of drugs. Principles of Pharmacokinetics, Bioavailability and Bioequivalence, pharmacogenetics, Adverse Drug Reaction, Drug interactions, Bioassays & Preclinical studies, Clinical Trials.

Unit-2

Pharmacology of Peripheral Nervous system:

Neurohumoral transmission (autonomic and somatic), Parasympathomimetics, Parasympatholytics, Sympathomimetics, adrenergic receptor and neuron, blocking agents, ganglionic stimulants and blocking agents, Neuromuscular blocking agents, Basics of ANS disorders.

Unit-3

Pharmacology of Respiratory System

Drugs used in treatment of Bronchial asthma, Dry cough, COPD (also Mucolytics, Expectorants, Antitussives)

Unit-4

Pharmacology of Nitric oxide, endothelins, ANP, purines.

Recommended Books for the syllabi are:

1. Pharmacological Basis Of Therapeutics By Goodman & Gillman.
2. Pharmacology And Pharmacotherapeutics By Satoshkar & Bhandarkar.
3. Essentials Of Pharmacotherapeutics By F.S.K. Barar.
4. Essentials Of Medical Pharmacology By K.D. Tripathi.
5. Pharmacology By Rang & Dale.

Reference Books:

1. Fundamentals Of Experimental Pharmacology By M.N. Ghosh.
2. Handbook Of Experimental Pharmacology By S.K. Kulkarni.
3. Pharmacology by V. J. Sharma.
4. Lippincot's Pharmacology by Heavy & Champ.
5. General P'cology : Basic Consept by H.L. Sharma.
6. Practicals in Pharmacology by Dr. Goyal.
7. Medical Pharmacology By Goth.
8. Pharmacology By Gaddum.
9. Principles Of Drug Action By Goldstein Aronow & Kalaman.
10. Lewis Pharmacology By Crossland.
11. Elements Of Pharmacology By Dr. Derasari & Dr. Gandhi.
12. Drug Interactions By Hansten.
13. Pharmacological Experiments On Isolated Preparations By Perry.
14. Drug Receptor- Rang HP.

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PC-514 Introduction to Drug Delivery Systems

SUBJECT CODE: PC 514

RATIONALE : To get acquainted with formulation, methods of preparation, evaluation and applications of Novel Drug Delivery Systems.

COURSE OBJECTIVES

To get acquaint knowledge of newly formed drug molecules of various types.

LEARNING OUTCOMES

The student should be able to:

1. The knowledge gained by the students during the study of this course can help them in handling of NDDS related research projects in Pharma industry.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 514	Introduction to Drug Delivery Systems	3	3	50	50	100

Unit-1

Immediate Release Novel Dosage Forms:

Fast dissolving tablets including Effervescent Tablets, Mouth dissolving tablet, Oral Films.

Unit-2

Oral Controlled Drug Delivery Systems :

Physicochemical and Biological factors influencing design, dissolution controlled systems, Diffusion controlled systems, Bioerodible systems, Release rate kinetics, General methods of design and evaluations of controlled release products such as Osmotically controlled systems, Ion Exchange systems, Pulsatile Drug Delivery Systems, Gastroretentive drug delivery systems.

Unit-3

Mucoadhesive Drug Delivery Systems:

Physiology of mucosa, mechanism of transmucosal permeation, Delivery through Gastro intestinal, buccal, rectal and vaginal routes.

Colon Specific Drug Deliver System:

Matrix tablet,Coated tablet, Encapsulated tablet

Unit-4

Transdermal Drug Delivery Systems:

The structure & function of skin Fundamental of skin permeation, kinetic evaluation, formulation design & optimization, Permeation enhancement techniques viz. Electrical, Chemical and Mechanical methods of permeation enhancements, recent advancements in skin delivery systems, Evaluation, Merits & Demerits.

Recommended Books for the syllabi are:

1. Modern Pharmaceutics, G.S. Banker and C.T. Rhodes, Marcel Dekker, Inc., New York.
2. Controlled Drug Delivery : J. R. Robinson and V. H. Lee, Marcel Dekker, Inc., New York.
3. Novel Drug Delivery Systems, Y.W. Chien, Marcel Dekker, Inc., New York.

Reference Books:

1. Progress in Controlled and Novel Delivery Systems, edited by N.K. Jain, CBS Publishers & Distributors, New Delhi.
2. Targeted & Controlled Drug Delivery, S. P. Vyas and R. K. Khar, CBS Publishers & Distributors, New Delhi.
3. Pharmaceutical Dosage Forms: Disperse system, Vol. I, II &III, Lierberman H. A. and Leon Lachman, Marcel Dekker, New York
4. Protein Formulation & Delivery, edited by E. J. Manally and J. E. Hastedt, Informa Healthcare, New York.
5. Encyclopedia of Pharmaceutical Technology, Jasmes Swarbrick and James C. Boylan, Marcel Dekker Inc., New York.
6. Handbook of Pharmaceutical Controlled Release Technology, Donald L. Wise, Marcel Dekker, USA.

PC-516: Practical

SUB CODE	TITLE OF SUBJECT	Credit	EVALUATION SCHEME		Total Marks
			Continuous Evolution	End Term Evolution	
PC 516	Practical	18	500	200	700

Practical:

1. Organic spotting of binary mixtures of Liquid + Liquid (all type)(Min 4-5).
2. Synthesis of aspirin from salicylic acid
3. Synthesis of N-acetyl glycine from glycine
4. Synthesis of benzillic acid from benzyl
5. Synthesis of benzil from benzoin
6. Synthesis of benzaldehyde phenyl hydroxime from benzaldehyde
7. To interpret the given IR spectra(chemical+drug).
8. To perform assay of Mefenemic acid as per IP'2007. 13
9. To perform assay of Calcium gluconate injection as per IP'2007.
10. To perform the assay of Isoniazide tablet as per IP'96.
11. To find out content of active ingredient of Metformine tablet as per IP'2007. 13
12. To perform the assay of active ingredient for Riboflavin as per IP'2007. 13
13. To perform content uniformity test for Paracetamol as per IP'2007. 13
14. To perform uniformity test for Co- trimoxzole as per IP'92007. 13
15. To study the effect of quenching on quinine sulphate by KI
16. To determine dissociation constant (pKa) of indicator by using UV-visible spectrophotometer.
17. Disinfection, sanitation and work practices.
18. Skin analysis.
19. Physical examination of hormonal solutions, steroids and flavons.
20. Vitamin Assay.
21. Surface tension of cosmetics.
22. Introduction to Experimental Pharmacology.
23. To study basic instruments used for isolated tissue experiments.
24. A. To study different laboratory animals.
    B. Introduction to CPCSEA its construction and its function (CPCSEA guidelines).
25. A. To study various methods of euthanasia.
26. B. To study various methods of anesthesia & method of disposal of animals.
27. Demonstration of mounting of isolated rat ileum.
28. To study PD_2 value of Ach/Histamine using rat/G.pig ileum using simulation software.
29. To study dose ratio of Carbachol/ Ach & Physostigmine/Ach using rat ileum using simulation software.
30. To study PA_2 value of Atropin/Mepyramine using rat/G.pig ileum using simulation software.
31. To find out nature of unknown drug using rat ileum using simulation software.
32. To study the effect of various drugs acting on neuromuscular junction using simulation software. (Computer Assisted Experiment).
33. To study the effect of various drugs on cat nictating membrane.(Computer Assisted Experiment).
34. Physical examination of hormonal solutions, steroids and flavons.
35. To determine Surface tension of prepared herbal cosmetics.
36. Detection and identification of proteins & amino acids.

37. Detection and identification of carbohydrates.
38. Detection and identification of Lipids.
39. Analysis of normal and abnormal constituents of urine

Curriculum for Semester VI

Semester VI

Course Code	Course Title	Credit		Total	Marks		Total
		Theory	Prac./Field		Internal	External	
PC 611	Basic Principles of Cosmetic Products	2	0	2	50	50	100
PC 612	Medicinal Chemistry – III	3	0	3	50	50	100
PC 613	Advanced Analytical Chemistry-IV	3	0	3	50	50	100
PC 614	Pharmacology II	2	0	2	50	50	100
PC 615	Phytochemistry	2	0	2	50	50	100
PC 616	Practical	--	18	18	500	200	700
Total		**12**	**18**	**30**	**750**	**450**	**1200**

PC-611 Basic Principles of Cosmetic Products

SUBJECT CODE: PC 611

RATIONALE: This subject discusses methodology, development and formulation of various cosmetic products.

COURSE OBJECTIVES

1. Understand rheology & solubilization of cosmetic products.
2. Understand basic principles of cosmetic products.
3. Know basic principles of novel concept of cosmetic formulation.
4. Understand plant scale up technique for cosmetic products.

LEARNING OUTCOMES

The student should be able to:

1. The learner will understand solubilization, interphase & dispersion technique of various formulations for cosmetic preparations.
2. The learners will acquire comprehensive knowledge of basics of formulation and development of cosmetic formulations.
3. The learner will understand novel concepts of formulations of various cosmetic preparations.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 611	Basic Principles of Cosmetic Products	2	2	50	50	100

Unit-1

- Definition of cosmetics, Introduction to different cosmetic formulations, emulsions, creams, lotions, suspensions, oils, powders etc.

- Different targeted cosmetic formulations like Skin-Whitening Agents, Anticellulite Products and Treatments, Baby Care Products, Cosmetics for the Elderly, Antiperspirants, Deodorants, Cooling Ingredients and Their Mechanism of Action, Oral Cosmetics, Hair Conditioners, Nail Cosmetics.

Unit-2

Vehicles used in Cosmetics: Functions, classification, preparation methods, characterization, Surfactants, Elastic Vesicles as Topical/Transdermal Drug Delivery Systems, Polymers Effect on Chemical Partition Coefficient Between Powdered Human Stratum Corneum and Water

Unit-3

Novel Concepts of Formulation development of cosmetics:

a) Encapsulation techniques for topical delivery: Vector identification, design and properties of vector, dermatological application, porous microsphere techniques.
b) Liposomal and aquasome as potential delivery techniques.
c) Iontophoresis to Enhance Cosmetics Delivery and its approaches.
d) Cosmetic patches and difference with pharmaceutical patches.

Recommended Books for the syllabi are:

1. Beginning Cosmetic Chemistry, 3rd Edition. Randy Schweller and Perry Romanowski.
2. Chemistry and Manufacture of Cosmetic Science, 4th Edition. Mitchell Schollman.
4. Harry's Cosmetology, 8th edition. Harry Ralph Gordon
5. Handbook of Cosmetic Science and Technology, 3rd Edition. Andre O Barrel.

Reference Books:

1. A Short Text Book on Cosmetology. K F De Polo.
2. Surfactants in Personal Care Products and Decorative Cosmetics, 3rd Edition. Linda D Rhein, Mitchell Scholssman and Anthony O Lenick.
3. Chemical and Physical Behaviour of Human Hair. Clarence R Robbins.

PC-612 Medicinal Chemistry-III

SUBJECT CODE: PC 612

RATIONALE: Basic chemistry learnt till previous semester is now getting extended to medicinal chemistry where the student learns the chemistry of complex drug molecules and how a chemical structure and alter the body functions.

COURSE OBJECTIVES :

The course is designed to make students familiar with the principles of medicinal chemistry as applied to pharmaceuticals and to study the synthetic approaches and structure activity relationship of different therapeutic class of drugs.

LEARNING OUTCOMES :

The student should be able to:

1. By the end of this course, the student should have a good understanding of the basic concepts of Medicinal chemistry.
2. Students should be able to describe in detail synthetic approaches, mechanisms of action as well as structure activity relationship of some important therapeutic class of Drugs.
3. The course may help the students in understanding rational approaches towards the design of important therapeutic agents and their biological implications.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 612	Medicinal Chemistry-III	3	3	50	50	100

Unit-1

The following classes of drugs will be discussed in relation to:

- Introduction, Chemical classification (if any), Chemical nomenclature, Mechanism of action, Synthesis of the agent mention in the bracket, Structure activity relationship & Therapeutic Uses

a) Sulphonamides and fluoroquinolones (sulphanilamide, sulphacetamide, sulphaguanidine, sulphathiazole, sulphadiazine, sulphafurazole, sulphamerizine, sulphamethoxazole).
b) Antimalarials (chloroquin, primaquin, amodiaquin, mepacrin hydrochloride, pyrimethamine).
c) Antimycobacterials (Antileprotic & Antitubercle agents) (isoneazid, para amino salicylic acid, pyrazinamide, ethambutol, ethionamide, prothionamide, meprazinamide).
d) Antifungal agents (metronidazole, fluconazole).

Unit-2

The following classes of drugs will be discussed in relation to:

- Introduction, Chemical classification (if any), Chemical nomenclature, Mechanism of action, Synthesis of the agent mention in the bracket, Structure activity relationship & Therapeutic Uses

a) Antiviral drugs including Anti-HIV drugs (amantadine).

b) Antineoplastic agents (methotrexate, chlorambucil, mustine, thio TEPA, cyclophospomide, 6-merceptopurine, hydroxyl urea).
c) Antiseptics and Disinfectants.

Unit-3

Introduction, Chemical classification (if any), Chemical nomenclature, Mechanism of action, Synthesis of the agent mention in the bracket, Structure activity relationship & Therapeutic Uses of Antibiotics:

beta-lactams, aminoglycosides, tetracyclines, macrolides, polyene & polypeptide antibiotics, chloramphenicol. (ampicillin, carbenicillin, cephalexin, penicillin-V, chloramphenicol).

Unit-4

Combinatorial Chemistry: introduction, principle, importance of new drug discovery, various synthetic approaches and library Purification.

Recommended Books for the syllabi are:

1. Wilson and Giswold's Textbook of Organic, Medicinal and Pharmaceutical Chemistry,J. N. Delagado and W. A. R. Remers, Eds, J. Lipponcott Co. Philadephia.
2. Principles of Medicinal Chemistry by W. C. Foye,, Lea & Febiger, Philadelphia.
3. Burger's Medicinal Chemistry, H. E. Wolff, Ed. John Wiley & Sons, New York Oxford University Press, Oxford.
4. 'Strategies for Organic Drug Synthesis & Design by Daniel Lednicer, John Wiley & sons, USA.

Reference Books:

1. Smith & William' s Introduction to the Principle of Drug Design and Action, 4th Edition, H. John Smith, Eds,CRS Press-Taylor & Francis Group, USA.
2. Text book of Drug Design & Discovery, 3rd Edition, Povl Krogsgaard-Larsan, Tommy Liljefors & ULF Madsen, Eds, Taylor & Francis Group, USA.
3. Walter Sneader' s Drug Discovery-A History, John Willy & Sons, Ltd. UK.
4. Vogel' s Text book of Practical Organic Chemistry, ELBS/ Longman, London.
5. Practical Organic Chemistry by Mann & Saunder,, Orient Longman, London.
6. Spectormetric identification of Organic compounds by R. M. Silverstein, G. Claytron Bassel's and T. C. Movvill, John Wiley & Sons, USA.
7. Practical Organic Chemistry by Hitesh Raval, Sunil Baldania and Dimal Shah, First Edition, Nirav & Rupal Prakashan.

PC-613 Advanced Analytical Chemistry-IV

SUBJECT CODE : PC 613

RATIONALE: Measuring Drug purity is a primary requirement to ensure the quality of drugs. Quantifying the purity of compound can be done by different techniques. Some of the most commonly used techniques will be taught in this subject. This will make the student capable to work in a quality control department of the pharmaceutical industry.

COURSE OBJECTIVES :

1. To make student learn the basic principles of various assay techniques commonly used in quality control department of any pharmaceutical industry.
2. To provide the hands on experience by actually conducting these assays in the lab.

LEARNING OUTCOMES :

The student should be able to:

1. Narrate the principles of methods and instruments used in assay of various drugs and chemicals.
2. Conduct assays of some drugs using these methods and instruments.
3. Describe basic principles and guidelines pertaining to quality assurance of drugs.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 613	Advanced Analytical Chemistry-IV	3	3	50	50	100

Unit-1

Fundamental of NMR & CMR Spectroscopy:

Principal, basic of NMR (Peak height, Peak signal, Chemical shift,) instrumentation and applications of NMR, Criteria for a compound to be NMR active. Basic components of instrumentation of PMR and CMR. Shielding- deshielding, splitting, TMS. Resolution and multiplicity.

Unit-2

Mass Spectroscopy

Theory, instrumentation and modifications; Unit mass and molecular ions; Important terms-singly and doubly charged ions, meta stable peak, base peak, is otropic mass peaks, relative intensity, etc.; Recognition of M+ ion peak; General fragmentation rules: Fragmentation of various classes Of organic molecules, including compounds containing oxygen, sulphur, nitrogen and halogens; α-, β-, allylic and benzylic cleavage.

Unit-3

Gravimetric analysis:

Precipitation techniques, Solubility products; The colloidal state, Supersaturation co-precipitation, Post-precipitation, Digestional washing of the precipitate, Filtration, Filter papers and crucibles,

Ignition, Thermogravimetric curves, Specific examples like barium sulphate, aluminium as aluminium oxide,calcium as calcium oxalate and magnesium as magnesium pyrophosphate, Organic precipitants

Recommended Books for the syllabi are:

1. Spectroscopic Identification of Organic Compounds. Silverstein, R. M., Bassler, G. C. & Morrill, T. C.
2. Spectroscopy of Organic Compounds. P. S. Kalsi, New Age International Ltd.
3. D.A. Skoog, F.J. Holler, S.R.Crouch, Principles of Instrumental Analysis, Thomson coporation,. 6th Ed.,2007.
4. Gary D. Christian, Analytical chemistry, John Wiley & Sons N.Y., 5th Ed.,1994.
5. J.A. Dean, Analytical chemistry handbook, ,McGraw hill Inc., 1st Ed.,1995.

Reference Books:

1. Practical NMR Spectroscopy. M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.
2. Kemp, W. Organic Spectroscopy 3rd Ed. W. H. Freeman & Co. (1991).
3. Introduction to NMR Spectroscopy. R. J. Abraham, J. Fisher and P. Loftus, Wiley.
4. Application of Spectroscopy of Organic Compounds. J. R. Dyer, Prentice Hall.
5. Spectroscopy Methods in Organic Chemistry. D. H. Williams, I. Fleming, Tata.
6. S.M.Khopkar, New Age International Pvt. Ltd., Basic Concepts of analytical Chemistry, 2nd Ed.,1998.
7. J.H.Kemedy, Analytical chemistry: principles, W.B.Saunder publishing, 2nd Ed., 1990.

PC-614 Pharmacology II

SUBJECT CODE: PC 614

RATIONALE : This is one of the core subjects of Pharmacy field where student learns the biological effects of drugs. The subject has direct application to the profession as it teaches the student about how the drug produce effect, what effects are produced, what side effects are produced, where and when it should be used etc.

COURSE OBJECTIVES

To learn the mechanism of action, pharmacological effects, pharmacokinetics, adverse effects, therapeutic application of various classes of drugs with special attention to drugs acting on cardiovascular, urinary, gastrointestinal system.

LEARNING OUTCOMES

The student should be able to:

1. Narrate the principles involved in measurement of drug effects.
2. Classify the drugs according to pharmacological classes.
3. Explain the mechanism of action, pharmacodynamic and pharmacokinetic effects of drugs, adverse effects, contraindications and therapeutic application of various classes of drugs.
4. Conduct some simple in vivo experiments to demonstrate the pharmacological actions of the drugs.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 614	Pharmacology II	2	2	50	50	100

Unit-1

Pathophysiology and Drugs used in :

Congestive Cardiac Failure, Angina, Myocardial Infarction, Cardiac Arrhythmias, Hypertension, Hyperlipidemia and Atherosclerosis, Anemia, Coagulation disordes, Shock.

Unit-2

Drugs Acting on Urinary System

Fluid and electrolyte balance, Diuretics, Anti diuretics, Urine acidifying and alkalinizing agents.

Unit-3

Pharmacology of Gastro Intestinal Tract :

antacid, antiemetics, antidiarroheal, laxatives, carminatives, appetizers, demulcents, mucolytics, Adsorbants, Astringents, Digestants Pathophysiology and Drugs used in: Peptic Ulcer & Inflammatory Bowel Disease.

- **Concepts of RIA, Radioligand Studies, ELISA, HTS**

Recommended Books for the syllabi are:

1. Pharmacological Basis Of Therapeutics By Goodman & Gillman.
2. Pharmacology And Pharmacotherapeutics By Satoskar & Bhandarkar.
3. Essentials Of Pharmacotherapeutics By F.S.K. Barar.
4. Essentials: Of Medical Pharmacology By K.D. Tripathi.
5. Pharmacology By Rang & Dale.

Reference Books:

1. Fundamentals Of Experimental Pharmacology By M.N. Ghosh.
2. Handbook Of Experimental Pharmacology By S.K. Kulkarni.
3. Exp. P'cology by R.V. Goyal.
4. Pharmacological Experiments On Isolated Preparations By Perry.
5. Medical Pharmacology By Goth.
6. Pharmacology By Gaddum.
7. Lewis Pharmacology By Crossland.
8. Textbook Of Pharmacology By Bowman & Rand.
9. Elements Of Pharmacology By Dr. Derasari & Dr. Gandhi.
10. Drug Interactions By Hansten.

PC-615 Phytochemistry

SUBJECT CODE: PC 615

RATIONALE : This is one of the core subjects of Pharmacy field where student learns the biological effects of drugs. The subject has direct application to the profession as it teaches the student about how the drug produce effect, what effects are produced, what side effects are produced, where and when it should be used etc.

COURSE OBJECTIVES

To make students familiar with Pharmacognostic study of tannin, resin and volatile oil containing crude drugs, utilized as medicine.

LEARNING OUTCOMES

The student should be able to:

1. Learn the pharmacognostic aspects specifically, the sources, the preparation methods and utilization of tannin, resin and volatile oil containing drugs.
2. Understand basic idea of extraction, isolation and separation of active phytoconstituents from medicinal plants.
3. Understand concept of phytochemical screening of the phytoconstituents obtained from the natural sources.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	Credit	Theory (hr/week)	EVALUATION SCHEME		Total Marks
				Theory		
				Internal	External	
PC 615	Phytochemistry	2	2	50	50	100

Unit-1

Study of drugs containing resins combinations:

Introduction, classification, general properties, chemical tests of resins. Pharmacognostic Studies of the following resin containing drugs: Colophony, Podophyllum, Jalap, Cannabis, Capsicum, myrrh, Asafoetida, balsam of Tolu, balsam of Peru, Benzoin, turmeric and Ginger.

Unit-2

Study of tannins and tannin containing drugs:

Introduction, classification, general properties, chemical tests. Drugs: Black catechu, pale catechu and Myrobalans.

Study of Volatile oil containing drugs:

Introduction, classification, general properties, chemical tests and General methods of obtaining volatile oils from plants. Pharmacognostic Studies of the following drugs, containing volatile oils: Mentha, Coriander, Caraway, Dill, Fennel, Cinnamon, Lemon peel, Orange peel, Lemon grass, Clove, Nutmeg, Eucalyptus, Chenopodium, Cardamom, Valerian, Sandalwood.

Unit-3

Basic idea of extraction, isolation and separation of active constituents from medicinal plants and Phytochemical Screening:

Basic principle of extraction. The factors which may affect the extraction process. Different types of extracts and their preparations. The comparative studies of different methods employed for extraction of phytoconstituents. Phyto chemical Screening of alkaloids, saponins, cardenolides, bufadienolides, flavonoids, tannins, anthraquinones, cyanogenetic glycosides and amino acids in different extracts.

Recommended Books for the syllabi are:

1. Pharmacognosy: C.K.Kokate, A.P.Purohit, S.B.Gokhale, Nirali prakashan, Pune, 39th Edition, 2007.
2. Pharmacognosy and pharmacobiotechnology, Ashutosh Kar, New Age International (P) Ltd, Publishers, 2nd edition 2007.
3. A Text Book of Pharmacognosy: C. S. Shah, J. S. Quadry, B. S. Shah Prakashan, Ahemedabad, 8th edition, 1990.
4. Trease and Evan's Pharmacognosy: W. C. Evans, W.B.Saunders Co., Singapore, 15th Edition 2008.
5. Text Book Pharmacognosy: T.E. Wallis, CBS Publishers and Distributors Delhi- 5th Edition, Reprint, 1997.

Reference Books:

1. Pharmacognosy and Phytochemistry, Part I and II, Vinod D. Rangari, Carrier Publications, 1st Edition, Reprint, 2007.
2. Pharmacognosy: V. E. Tylar, L. R. Brady, J. E. Habbers, Lea and Febgir Philadelphia, 8th Edition, 1981.
3. Cultivation and Utilization of Aromatic Plants, Handa S.S. and Kaul M.K., Regional Research Laboraotry, Jammu, 1st Edition, 1997.
4. Pharmacognosy of powdered crude drugs: M. A. Iyenger, Manipal Power Press, 1st Edition, 1974.
5. Mukherji P. K., Quality Control of Herbal Drugs, Business Horizon Pharma. Publishers, 1st Edition, 2002.
6. Herbal drug technology, S. S. Agrawal and M. Paridhavi, Univeristies Press, 1st Edition, 2007.
7. Essentials of Pharmacognosy, S. H. Ansari, Birla Publications Pvt. Ltd., 1st edition, 2005-2006.
8. Microscopic profile of powdered drugs used in Indian systems of medicine, Malti G. Chauhan and Pillai A.P.G., volume 1, Leaf drugs, (2005), Gujarat Ayurved University, Jamnagar.
9. Microscopic profile of powdered drugs used in Indian systems of medicine, Malti G. Chauhan and Pillai A.P.G., volume 2, bark drugs, (2007), Gujarat Ayurved University, Jamnagar.

PC-616: Practical

SUB CODE	TITLE OF SUBJECT	Credit	EVALUATION SCHEME		Total Marks
			Continuous Evolution	End Term Evolution	
PC 616	Practical	18	500	200	700

Practical:

1. Synthesis of sulphanilamide from acetanilide.
2. Synthesis of 5,5 diphenyl hydantoin from benzil and urea
3. Synthesis of Aspirin from acetyl salicylic acid by Microwave synthesis approach.
4. Synthesis of paracetamol from p-aminophenol.
5. Synthesis of Magnasone-II from p-nitro aniline and a-naphthol.
6. To determine sulphate content as Barium sulphate by gravimetric method.
7. To determine chloride content as Silver chloride by gravimetric method.
8. Demonstration of the isolated perfused mammalian heart by Langendroff's technique.
9. To study the effect of various drugs on isolated frog's heart using simulation software.
10. To study the effect of various drugs on rat/cat/dog blood pressure using simulation software.
11. To study the effect of various drugs on cilliary motility of frog (CAE).
12. To study the antidiarrhoeal effect of lopamide on castor oil/Carbachol induced diarrhea.
13. To study effect of Aspirin on aggregation & deaggregation of platelets in human plasma.
14. Bioassay of Heparin.
15. To perform bioassay of Ach/ Histamine using Rat/ Guinea pig ileum by Graphical method.
16. To perform bioassay of Ach using Rat ileum by Matching method.
17. To study the effect of urea, furosemide & Acetazolamide on rat urine output.
18. Pharmacognostic study of Coriander fruit and histological assessment of the powdered drug.
19. Pharmacognostic study of Cinnamon bark and histological assessment of the powdered drug.
20. Pharmacognostic study of Cardamom seeds and histological assessment of the powdered drug.
21. Pharmacognostic study of Mentha leaf and histological assessment of the powdered drug.
22. Morphological Evaluation of the Tannin and Resin containing drugs.
23. Chemical Tests for Tannins and Resins.
24. Isolation of volatile oil.
25. Successive solvent extraction and detection of phytoconstituents.
26. Preparation of extracts by different methods and determine the extractive values.
27. Determination of iodine value of given oil.
28. Determination of saponification value of given oil
29. Isolation of caffeine from tea.
30. Isolation of calcium citrate from lemon
31. Isolation of pectin from lemon peel.
32. Isolation of glycyrrhizine from liquorice
33. Isolation of nicotine from tobacco leaf
34. Estimation of total tannins in given sample by redox titration
35. Estimation of carvone in dill oil using titrimetric method.
36. Colorimetric Estimation of total Rauwolfia alkaloid as reserine from rauwolfia root.