Hemchandracharya North Gujarat University, Patan

Bachelor of Vocation

Programme on

Pharmaceutical Chemistry

Offered at

Pramukh Swami Science and H.D. Patel Arts College

Sarva Vidyalaya Campus,Kadi

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.

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

   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

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=9Marks)

(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.

Model paper for B.Voc Pharmaceutical Chemistry Internal Examination

Hemchandracharya North Gujarat University, Patan
Bachelor of Vocation
Pharmaceutical Chemistry Semester I
Mid SEM 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.

B.VOC. Pharmaceutical Chemistry Course Structure

Semester 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**

Semester 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**

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**

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**

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**

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	Industrial Training/Project/Practical	--	18	18	500	200	700
Total		**12**	**18**	**30**	**750**	**450**	**1200**

Curriculum for Semester III

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.

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	Industrial Training/Project/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.
