

**SYLLABUS**

**H.N.B. GARHWAL UNIVERSITY, SRINAGAR-GARHWAL**

**(A CENTRAL UNIVERSITY)**

**2018-19 ONWARDS**

**DEPARTMENT OF PHARMACEUTICAL CHEMISTRY**

**MASTER OF SCIENCE**

**PHARMACEUTICAL CHEMISTRY**

**(TWO YEARS COURSE - SEMESTER SYSTEM)**

Admission of the Master's Program in Pharmaceutical Chemistry shall be through entrance examination conducted by the University and the program shall be based on credit system in which credit defines the quantum of content/ syllabus prescribed for a course system and determines the number of hours of instruction per week.

The student shall be eligible for admission to a Master's Degree Program in Pharmaceutical Chemistry after he/she has successfully completed a three year B. Sc or B.Pharm. undergraduate degree or earned prescribed number of credits or through the examinations conducted by University as equivalent to an undergraduate degree. Core courses prescribed for every Semester shall be mandatory for all students registered for the Master's Program in Pharmaceutical Chemistry and shall carry minimum 54 credits. Besides this there shall be Elective courses offered in semester III and IV and shall carry a minimum of 18 credits. A self study course would comprise of maximum 09 credits of which one minimum 03 credits shall be mandatory which shall not be included while calculating grades.

Each candidate is expected to participate in the industrial training and excursions required for the Laboratory Courses when organized by the Department. Subsequent to that the student would have to present a detailed report of such trainings at the time of Semester Practical examination. In order to qualify for a two year master's degree, a student must acquire a minimum of 72 credits including a minimum of 18 credits in electives choosing two elective may be (leading to a minimum 06 credits) offered by other departments and one qualifying self study course of minimum 03 credits. Dissertation (Project) is a core one mandatory for every student. Dissertation (Project) should be completed under the guidance of a faculty member in the same Department or Industry or research organization. In case of Industry / research organization one member of that body can also be included as project guide. The dissertation is to be allotted in the beginning of III Semester and would be submitted during the examination of the IV Semester.

**M.Sc. PHARMACEUTICAL CHEMISTRY- I SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Quantitative Analytical Methods	Core	SOS/PC/C001	40	60	51	3	0	0	3
2.	Modern Analytical Methods	Core	SOS/PC/C002	40	60	51	3	0	0	3
3.	Basic Pharmacology	Core	SOS/PC/C003	40	60	51	3	0	0	3
4.	Stereochemistry and Reaction Mechanisms	Core	SOS/PC/C004	40	60	51	3	0	0	3
5.	Laboratory- I (Pharmaceutical Analysis)	Core	SOS/PC/C005	40	60	51	0	0	3	3
6.	Laboratory- II (Pharmaceutical Chemistry)	Core	SOS/PC/C006	40	60	51	0	0	3	3

**Core Credits = 18****M.Sc. PHARMACEUTICAL CHEMISTRY- II SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Advance Analytical Techniques	Core	SOS/PC/C007	40	60	51	3	0	0	3
2.	Drug Delivery and Biopharmaceutics	Core	SOS/PC/C008	40	60	51	3	0	0	3
3.	Chemistry of Natural Products	Core	SOS/PC/C009	40	60	51	3	0	0	3
4.	Medicinal Chemistry	Core	SOS/PC/C010	40	60	51	3	0	0	3

5.	Laboratory-I (Formulation and Evaluation of Pharmaceutical Products)	Core	SOS/PC/C011	40	60	51	0	0	3	3
6.	Laboratory-II (Chemistry of Natural Products).	Core	SOS/PC/C012	40	60	51	0	0	3	3

**M.Sc. PHARMACEUTICAL CHEMISTRY SELF STUDY COURSE FOR THE II SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Hospital Training	Self Study	SOS/PC/S001	40	60	51	0	3	0	3
2.	Forensic Pharmacy	Self Study	SOS/PC/S002	40	60	51	0	3	0	3

**Core Credits= 18 with additional 03 Credits of Self Study course**

**M.Sc. PHARMACEUTICAL CHEMISTRY- III SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Drug Design	Core	SOS/PC/C015	40	60	51	3	0	0	3
2.	Laboratory –I (Drug Design)	Core	SOS/PC/C013	40	60	51	0	0	3	3
3.	Laboratory-II  PHARMACEUTICAL TECHNOLOGY	Core	SOS/PC/C014	40	60	51	0	0	3	3
4.	Elective	Elective	Code of Elective	40	60	51	3	0	0	3
5.	Elective	Elective	Code of Elective	40	60	51	3	0	0	3
6.	Elective	Elective	Code of Elective	40	60	51	3	0	0	3

**M.Sc. PHARMACEUTICAL CHEMISTRY- ELECTIVE PAPERS FOR THE III SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	General Pharmaceutics	Elective	SOS/PC/E001	40	60	51	3	0	0	3
2.	Pharmacodynamic agents	Elective	SOS/PC/E002	40	60	51	3	0	0	3
3.	Phytopharmaceuticals and Nutraceuticals	Elective	SOS/PC/E003	40	60	51	3	0	0	3
4.	Computers	Elective	SOS/PC/E004	40	60	51	3	0	0	3
5.	Biostatistics	Elective	SOS/PC/E005	40	60	51	3	0	0	3
6	Pharmaceutical Biochemistry	Elective	SOS/PC/E006	40	60	51	3	0	0	3
7	Advance Drug Delivery Systems	Elective	SOS/PC/E007	40	60	51	3	0	0	3
8	Spectroscopy	Elective	SOS/PC/E008	40	60	51	3	0	0	3
09	Applied Microbiology and Biotechnology	Elective	SOS/PC/E009	40	60	51	3	0	0	3

**M.Sc. PHARMACEUTICAL CHEMISTRY SELF STUDY COURSE FOR THE III SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Industrial Training	Self Study	SOS/PC/S003	40	60	51	0	3	0	3
2.	Pharmaceutical Industrial Management	Self Study	SOS/PC/S004	40	60	51	0	3	0	3

**Core Credits 09 + Elective Credits 09; Total Credits= 18 + 03 credits of self study.**

**M.Sc. PHARMACEUTICAL CHEMISTRY- IV SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Project from parent institute/industry /Research Organizations. Project should be completed under the guidance of a faculty member in the same Department or Industry or research organization. In case of Industry / research organization one member of that body can also be included as project guide.	Core	SOS/PC/C016	40	60	51	0	0	9	9
2.	Elective	Elective	Code of Elective	40	60	51	3	0	0	3
3	Elective	Elective	Code of Elective	40	60	51	3	0	0	3
4	Laboratory course	Elective	Code of Elective	40	60	51	0	0	3	3

**M.Sc. PHARMACEUTICAL CHEMISTRY- ELECTIVE PAPERS FOR THE IV SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Herbal Drug Technology	Elective	SOS/PC/E010	40	60	51	3	0	0	3

2.	Advance Organic Chemistry	Elective	SOS/PC/E011	40	60	51	3	0	0	3
3.	Drug regulatory Affairs	Elective	SOS/PC/E012	40	60	51	3	0	0	3
4.	Essential of Traditional Medicine	Elective	SOS/PC/E013	40	60	51	3	0	0	3
5.	Cosmeticology	Elective	SOS/PC/E014	40	60	51	3	0	0	3
6.	Laboratory I Herbal drug Technology	Elective	SOS/PC/E015	40	60	51	0	0	3	3
7.	Laboratory II (Pharmaceutical Drug Analysis)	Elective	SOS/PC/E016	40	60	51	0	0	3	3
7.	Laboratory III (Cosmetics Evaluation)	Elective	SOS/PC/E016	40	60	51	0	0	3	3

**M.Sc. PHARMACEUTICAL CHEMISTRY SELF STUDY COURSE FOR THE IV SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Traditional Healthcare system of Uttarakhand including Ayurvedic Medicines	Self Study	SOS/PC/S003	40	60	51	0	3	0	3
2.	Nanotechnology	Self Study	SOS/PC/S004	40	60	51	0	3	0	3

**Core Credits 09 + Elective Credits 09; Total Credits= 18 + 03 Credits of Self Study**

**Grand Total: Core Credits 54 + Elective Credits 18 = 72**

With a total of 09 Credits (3+3+3) Credits in II, III and IV semesters of Self Study course.

01 Credit= 01 hour of lecture/instructions per week. 01 Credit course = 15 hours of lectures per semester.

03hours of laboratory course shall be considered equivalent to 01 hour of lecture.

### **Dissertation/ Project Work**

Dissertation is a core one and mandatory for every student. The dissertation is to be allotted in the beginning of III Semester and would be submitted at the time of the examination of IV Semester. The distribution of marks for the Dissertation will be as below:

Periodical presentation	: 20 Marks
Dissertation	: 60 Marks
Viva Voce	: 20 Marks
<b>Total</b>	<b>: 100 Marks</b>

The Dissertation would carry 09 credits in all.

The dissertation/ Project report shall be evaluated jointly by the supervisor and one external examiner.

Following topics/research fields are proposed to undertake Dissertation/ Project Work.

Traditional Health care System of Uttarakhand

Study of Medicinal plants of Uttarakhand Himalaya

Quality control of herbal drugs, Quality control of Synthetic drugs

Any other current trends / topics suggested by the Departmental committee may also be considered for the dissertation/project work other current problems / topics suggested by the Departmental committee.

### **M.Sc. PHARMACEUTICAL CHEMISTRY- I SEMESTER**

S.	Subject Title	Category	Course code	Maximum Marks 100	L	T	P	Credits
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No				Internal	External	Minimum				
1.	Quantitative Analytical Methods	Core	SOS/PC/C001	40	60	51	3	0	0	3
2.	Modern Analytical Methods	Core	SOS/PC/C002	40	60	51	3	0	0	3
3.	Basic Pharmacology	Core	SOS/PC/C003	40	60	51	3	0	0	3
4.	Stereochemistry and Reaction Mechanisms	Core	SOS/PC/C004	40	60	51	3	0	0	3
5.	Laboratory- I (Pharmaceutical Analysis)	Core	SOS/PC/C005	40	60	51	0	0	3	3
6.	Laboratory- II (Pharmaceutical Chemistry)	Core	SOS/PC/C006	40	60	51	0	0	3	3

**Core Credits = 18**

**M. Sc. Pharm. Chem. 1<sup>st</sup> Sem.**

**QUANTITATIVE ANALYTICAL METHODS  
CORE COURSE: PAPER- I; CODE- (SOS/PC/C001)**

## **Unit I**

### **Fundamental of volumetric analysis**

Methods of expressing concentrations, primary and secondary standards.

**Neutralization reactions:** Theory of indicators and neutralizations indicators.

## **Unit II**

### **Oxidation-reduction titration**

Principle of oxidation reduction filtrations, redox indicators & their use in pharmaceutical analysis.

**Precipitation titration :** Theory of precipitation titrations and use of adsorption indicators.

## **Unit III**

**Gravimetric analysis:** Method of gravimetric analysis

## **Unit IV**

### **Complexometric titrations**

Complexometric methods using EDTA, principle of complexometric titrations, chelating agents, indicators, titrations with disodium edetate.

## **Unit V**

### **Nonaqueous titrations**

General discussion and principle of titrations in non-aqueous media, aprotic, protophilic, protogenic and amphiprotic solvents. Titrations with perchloric acid, potassium methoxide and tetrabutyl ammonium hydroxide.

## **BOOKS SUGGESTED**

1. A. H. Becket and J. B. Stenlake, Practical Pharmaceutical Chemistry, Part I, 4<sup>th</sup> ed., CBS Publishers & Distributors, New Delhi, 1997.
2. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney Vogel's Text Book of Quantitative Chemical Analysis 5<sup>th</sup> ed., ELBS, U.K., 1989
3. A. Keneth & A. Connors, A Text Book of Pharmaceutical Analysis, 3<sup>rd</sup> ed., Wiley Interscience Singapore, 1982.

**M. Sc. Pharm. Chem. 1<sup>st</sup> Sem.**

## **ANALYTICAL TECHNIQUES**

## **CORE COURSE: PAPER-II; CODE- (SOS/PC/C002)**

### **Unit-I**

Chromatography, Principles of separation, application of techniques, absorption, partition, paper and thin layer chromatography. HPTLC, HPLC, Gas Chromatography, GLC, Ionexchange Chromatography and Gel Electrophoresis, Colorimetry, theory, methods of colour measurements or comparison, instrumentation.

Spectrofluorimetry, instrumentation, application.

### **Unit-II**

Atomic absorption and flame emission spectroscopy, theory, instrumentation, atomic absorption spectrophotometers, structure determinations.

Principle, techniques, instrumentation & application including interpretation of data of UV spectrophotometry & infrared spectrophotometry.

### **Unit-III**

Optical rotation, its significance, instrumentation.

Optical rotatory dispersion-terminology, plain curve, rotatory dispersion & circular dichroism and octane rule.

### **BOOKS SUGGESTED**

1. Robert M. Silverstein, Francis X. Webster, Spectrometric identification of organic compounds, 6<sup>th</sup> ed. John Wiley and Sons-Inc 1998.
2. Comin N. Banwell, Elian M. McCash, Fundamentals of molecular spectroscopy 4<sup>th</sup> ed. Tata McGraw -Hill Publishing Company Limited New Delhi, 1995.
3. A.H. Becket and J.B. Stenlake, Practical Pharmaceutical Chemistry, part- II, 4<sup>th</sup> ed., CBS Publishers & Distributors, New Delhi, 1997.
4. W. Kemp, Organic Spectroscopy, 1<sup>st</sup> ed. ELBS/Macmillan, London, 1975.

**M. Sc. Pharm. Chem. 1<sup>st</sup> Sem.**

### **BASIC PHARMACOLOGY**

## **CORE COURSE: PAPER- III; CODE- (SOS/PC/C003)**

### **Unit-I**

History of development of Pharmacology, introduction & general principles of route of drug administration, pharmacokinetics (absorption, distribution, metabolism & excretion) & pharmacodynamics (general mechanism of drug action).

Elementary introduction to adverse drug reactions & drug interactions, Drug allergy.

### **Unit-II**

General concepts of toxicity, Acute, subacute & chronic toxicity tests, teratogenicity & carcinogenicity, itrogenic diseases, LD<sub>50</sub>, ED<sub>50</sub>, tolerance, habituation & addiction.

### **Unit-III**

Bio-assays :General principles, general methods, biological variations & animal ethics. Bioassays of insulin, heparin, d-tubocurarin, digitalis, acetylcholine, adrenaline, histamine.

### **BOOKS SUGGESTED**

1. Goodman & Gillman, The Pharmacological Basis of Therapeutics 9<sup>th</sup> ed., McGraw Hill Companies, New York, USA, 1996.
2. Katzung G. Bertram, Basic and Clinical Pharmacology, 8<sup>th</sup> ed., McGraw Hill Companies, New York, USA, 2001.
3. Rang H.P., Dale M.M., Ritter J.M., Pharmacology, 4<sup>th</sup> ed., Churchill livingstone, N. Y., 1999.
4. R.S. Satoshkar, Pharmacology and Pharmacotherapeutics, vol. I & II: 16<sup>th</sup> ed., Mumbai Popular Prakashan, 1999.
5. Munson L. Paul, Principles of Pharmacology, Chapman & Hill, N. Y. 1995.
6. S. K. Kulkarni & P.C. Dandiya, Introduction to Pharmacology, 5<sup>th</sup> ed. Vallabh Prakasha, 1998.
7. Laurence & Bennett, Clinical Pharmacology, 8<sup>th</sup> ed., Churchill Livingstone, N. Y. 1997.
8. S. D. Seth, Text Book of Pharmacology, 2<sup>nd</sup> ed. Churchill Livingstone Pvt. Ltd., New Dlhi.
9. F.S.K. Barar, Essential of Pharmacotherapeutics, 3<sup>rd</sup> ed. S. Chand and Company Ltd., New Delhi, 1995.
10. K.D. Tripathi, Essentials of Medical Pharmacology, 9<sup>th</sup> ed., Jaypee Brothers New Delhi, 1995.

**M. Sc. Pharm. Chem. 1<sup>st</sup> Sem.**

### **STEREOCHEMISTRY AND REACTION MACHANISM**

## **CORE COURSE: PAPER- IV; CODE- (SOS/PC/C004)**

### **Unit-I**

Optical isomerism, configuration, Cahn-Ingold-Prelog rule for designation of configuration. Stereochemistry of carbon compounds with no chiral atom, Biphenyls, Allenes,. Geometrical isomerism & stereochemistry of olefins.

### **Unit-II**

Stereoisomerism of rings, stability of rings, ease of ring formation, Actual shape of six membered rings & its relation to properties & reactivity.

### **Unit-III**

Mechanisms involving Aromatic eletrophilic reaction, Aromatic nucleophilic reactions, free radical reactions and elimination mechanism.

### **Unit-IV**

Study of Name Reactions such as: Fries Rearrangement Beckmann rearrangement, Hofmann rearrangement & Hoffmann's degradation, Curtius reaction, Schmidt Reaction, Claisen's Condensation, Wittig Reaction, Oppenauer oxidation, Meerwein Ponderoff Valery Reduction, Birch Reduction, Clemmensen reduction, Reimer-Tiemann Reaction, Wolf Kishner's Reduction, Michael's Condensation, Pinacol-Pinacolone Rearrangement, Aldol Condensation, Cannizaro's Reaction.

### **BOOKS SUGGESTED**

1. E.L. Eliel Stereochemistry of carbon compounds, Tata McGra Hill Publishing Company New Delhi 1975.
2. Jerry March, Advance organic Chemistry 4<sup>th</sup> ed.. A Wiley-Interscience Publication, 1999.

**M. Sc. Pharm. Chem. 1<sup>st</sup> Sem.**

### **LABORATORY I- PHARMACEUTICAL ANALYSIS**

**CORE COURSE: PAPER- V; CODE- (SOS/PC/C005)**

Experiments based on SOS/PC/C001 Theory paper

Standardization of analytical weights and calibration of volumetric apparatus.

Titrametric analysis including acid base titration, redox titration, precipitation titrations, gravimetric analysis.

**BOOKS SUGGESTED**

1. A. H. Becket and J. B. Stenlake, Practical Pharmaceutical Chemistry, Part I, 4<sup>th</sup> ed., CBS Publishers & Distributors, New Delhi, 1997.
2. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney Vogel's Text Book of Quantitative Chemical Analysis 5<sup>th</sup> ed., ELBS, U.K., 1989
3. A. Keneth & A. Connors, A Text Book of Pharmaceutical Analysis, 3<sup>rd</sup> ed., Wiley Interscience Singapore, 1982.

**M. Sc. Pharm. Chem. 1<sup>st</sup> Sem.**

**LABORATORY II - PHARMACEUTICAL CHEMISTRY**

**CORE COURSE: PAPER- VI; CODE (SOS/PC/C006)**

1. Experiments on Identification of Organic Compounds and Mixtures.
2. Synthesis of organic compounds

**BOOKS SUGGESTED**

1. Vogel's Textbook of Practical Organic Chemistry, ELBS
2. Practical Organic Chemistry by Vishnoi

**M.Sc. PHARMACEUTICAL CHEMISTRY- II SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Advance Analytical Techniques	Core	SOS/PC/C007	40	60	51	3	0	0	3
2.	Drug Delivery and Bio-pharmaceutics	Core	SOS/PC/C008	40	60	51	3	0	0	3
3.	Chemistry of Natural Products	Core	SOS/PC/C009	40	60	51	3	0	0	3
4.	Medicinal Chemistry	Core	SOS/PC/C010	40	60	51	3	0	0	3
5.	Laboratory - I (Formulation and Evaluation of Pharmaceutical Products)	Core	SOS/PC/C011	40	60	51	0	0	3	3
6.	Laboratory-II (Chemistry of Natural Products).	Core	SOS/PC/C012	40	60	51	0	0	3	3

**M.Sc. PHARMACEUTICAL CHEMISTRY SELF STUDY COURSE FOR THE II SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Hospital Training	Self Study	SOS/PC/S001	40	60	51	0	3	0	3
2.	Forensic Pharmacy	Self Study	SOS/PC/S002	40	60	51	0	3	0	3

**Core Credits= 18 with additional 03 Credits of Self Study course**

**M. Sc. Pharm. Chem. II<sup>nd</sup> Sem.**

**ADVANCE ANALYTICAL TECHNIQUES**

**CORE COURSE: PAPER- I; CODE (SOS/PC/C007)**

**UNIT-I**

Molecular Emission Spectroscopy: Principle, molecule exhibiting fluorescence, Factors interfering with fluorescence intensity and Application, Raman Spectroscopy-Principle, Instrumentation and Application

**Unit-II**

Mass Spectroscopy: Principle, techniques, instrumentation, fragmentation pattern & structural elucidation of compounds. GC-MS and LC-MS Principle and Application.

**Unit-III**

Proton Magnetic Resonance, Principle, techniques, instrumentation, <sup>1</sup>H-NMR signals, chemical shift, spin-spin coupling, shielding deshielding effect, diamagnetic anisotropy, geminal coupling, AMX, ABX, ABC system, shift reagents & interpretation of spectra. <sup>13</sup>C-NMR, introduction and interpretation of data.

**Unit-IV**

Application of spectroscopic techniques to structural elucidation, introduction aids to spectral interpretation exercises.

Microbiology assays, Principles of microbiological assays, assays of vitamins & antibiotics.

**BOOKS SUGGESTED**

1. Robert M. Silverstein, Francis X. Webster, Spectrometric identification of organic compounds, 6<sup>th</sup> ed. John Wiley and Sons-Inc 1998.
2. Comin N. Banwell, Elian M. McCash, Fundamentals of molecular spectroscopy 4<sup>th</sup> ed. Tata McGraw -Hill Publishing Company Limited New Delhi, 1995.
3. A.H. Becket and J.B. Stenlake, Practical Pharmaceutical Chemistry, part- II, 4<sup>th</sup> ed., CBS Publishers & Distributors, New Delhi, 1997.



4. W. Kemp, Organic Spectroscopy, 1<sup>st</sup> ed. ELBS/Macmillan, London, 1975.

**M. Sc. Pharm. Chem. II<sup>nd</sup> Sem.**

**DRUG DELIVERY SYSTEM & BIOPHARMACEUTICS**

**CORE COURSE: PAPER- II; CODE- (SOS/PC/C008)**

**Unit-I-**Types, advantages, disadvantages & formulation of oral dosage forms including:

- a) Liquid dosage forms like solution, syrups, suspension & emulsion.
- b) Solid dosage forms like tablets, capsules etc.

**Unit-II-**Types, advantages, disadvantages & formulation of parenteral. Dosage forms & topical semi-solid dosage forms. Quality control of various dosage forms.

**Unit-III-**Quality Control of various dosage forms.

Disintegration, Disintegration time, factors affecting disintegration.

Dissolution, Dissolution models, factors affecting dissolution rate, co-rrrelation of dissolution with bioavailability. Factors affecting drug absorption including physicochemical, biological & Pharmaceutical Passive Diffusion, Active Diffusion.

**Unit-IV-Drug disposition:** Distribution in blood, plasma protein binding, cellular distribution, drug excretion, biotransformation of drugs.

**Bioavailability :** Concept of of bioavailability & comparative bioavailability, methods of estimation of bioavailability, bioequivalence studies.

**BOOKS SUGGESTED**

1. Hand book of Basic Pharmacokinetics-Ritschel, W.A., Drug Intelligenc Publication, M. Hamilton, 1977.
2. Fundamentals of Clinical Pharmacokinetics-Wagner, J.C., Drug Intelligence Publication, M. Hamilton, 1975.
3. Remington's Pharmaceutical Sciences-Gennaro A.R., ed., 19<sup>th</sup> Edition, Mack Publishing kco., Easton, PA. 1995.
4. Clinical Pharmacokinetics-Rowland, M, & Tozer, N., 2<sup>nd</sup> edition, Lea & Febiger, Philadelphia, 1989.
5. Pharmacokinetics-Gibaldi M. & Perrier, D., 2<sup>nd</sup> ed., Marcel Dekker, New York, 1982.
6. Pharmacokinetics for the pharmaceutical scientist-Wagner, J.C., Technomic Publishing AG, Switzerland, 1993.
7. Biopharmaceutics and Pharmacokinetics- Notrari, R.E., 2<sup>nd</sup> ed., marcel Dekker, New York, 1975.
8. Biopharmaceutics and Pharmacokinetics: Bramhankar & Jaiswal.

**CHEMISTRY OF NATURAL PRODUCTS**

**CORE COURSE: PAPER- III; CODE (SOS/PC/C009)**

**Unit-I**

**Heterocyclic Compounds:** Five membered heterocycles: Furan, Thiophene, pyrrole, thiazole, pyrazole, oxazole, Six membered: Pyridine, pyrimidine, Quinoline.

**Unit-II**

**Carbohydrate :** Introduction, mutarotation, ring structure of glucose, configuration of monosaccharides, structure elucidation of disaccharides, sucrose, maltose, lactose, polysaccharides, starch. Glycosides arbutin, amygdaline.

**Unit-III**

**Alkaloids :** General introduction, distribution in plants, isolation & purification. General methods of structure determination. Structural elucidation of atropine, quinine, Nicotine

**Unit-IV**

**Terpenoids :** General introduction, isolation, purification, structure elucidation of citral, menthol, camphor,

**BOOKS SUGGESTED**

1. I.L. Finar, Organic chemistry, Vol. II, 1<sup>st</sup> Indian ed., Pearson Education Pte Ltd Indian Branch, Delhi, 2002.
2. O.P. Agarwal, Chemistry of Natural Products, Vol. I & II, 7<sup>th</sup> ed., Goel Publishing House, Meerut, 1983.

**MEDICINAL CHEMISTRY**

**CORE COURSE: PAPER- IV; CODE (SOS/PC/C010)**

The Following topics shall cover –Nomenclature and classification of each topic, Structure Activity Relationship(SAR) (where stand) ,Mode of action ,Biochemical and Molecular basis (where applicable) and Therapeutic uses of :

Sulphonamides, penicillins & semisynthetic penicillins.

Cephalosporins, tetracyclines & Aminoglycosides, Antibiotics

Antimycobacterial agents-anti-T.B. & antileprosy drugs. Antimalarials.

Antiamobic & antiprotozoal

Antihelminthics

Antifungal

Anticancer

Antiviral

**BOOKS SUGGESTED**

1. William O. Foye, Principles of Medicinal Chemistry, 3<sup>rd</sup> ed., Varghese Publishing House, Mumbai, 1989.
2. Jaime N. Delgado & William A. Remers, Wilson and Gisvold's, Text Book of Organic Medicinal and Pharmaceutical Chemistry, 9<sup>th</sup> ed. J.B. Lippincott Company, Philadelphia, 1991.
3. Manfred E. Wolff, Burger's medicinal Chemistry and Drug Discovery, Vol. I to V, 5<sup>th</sup> ed., A Wiley-Interscience publication John Wiley & Sons, Inc. (New York), 1995.
4. Kadam & Mahadik, Bothara, Principles of Medicinal Chemistry vol. I & II, 4<sup>th</sup> ed. Nirali Prakash Pune, 1997

**M. Sc. Pharm. Chem. II<sup>nd</sup> Sem.**

**LABORATORY I – Formulation and Evaluation of Pharmaceutical Products**

**CORE COURSE; CODE (SOS/PC/C011)**

Experiments based on Formulation and Evaluation of Pharmaceutical Products.

**BOOKS SUGGESTED**

1. William O. Foye, Principles of Medicinal Chemistry, 3<sup>rd</sup> ed., Varghese Publishing House, Mumbai, 1989.
2. Jaime N. Delgado & William A. Remers, Wilson and Gisvold's, Text Book of Organic Medicinal and Pharmaceutical Chemistry, 9<sup>th</sup> ed. J.B. Lippincott Company, Philadelphia, 1991.
3. Manfred E. Wolff, Burger's medicinal Chemistry and Drug Discovery, Vol. I to V, 5<sup>th</sup> ed., A Wiley-Interscience publication John Wiley & Sons, Inc. (New York), 1995.

**M. Sc. Pharm. Chem. II<sup>nd</sup> Sem.**

**LABORATORY II -CHEMISTRY OF NATURAL PRODUCTS**

**CORE COURSE; CODE (SOS/PC/C0012)**

Experiments based on theory paper SOS/PC/C009

Laboratory II shall constitute of the following:

Experiments based on the determination of saponification value, acid value, ester value and iodine value of vegetable oils.

Extraction and isolation of compounds from the different plants.

**BOOKS SUGGESTED**

- 1 I.L. Finar, Organic chemistry, Vol. II, 1<sup>st</sup> Indian ed., Pearson Education Pte Ltd Indian Branch, Delhi, 2002.
- 2 O.P. Agarwal, Chemistry of Natural Products, Vol. I & II, 7<sup>th</sup> ed., Goel Publishing House, Meerut, 1983.
3. Pharmacognosy: Trease and Evans
4. Pharmacognosy: C. K Kokate

**M. Sc. Pharm. Chem. II<sup>nd</sup> Sem.**

**HOSPITAL TRAINING  
SELF STUDY COURSE: PAPER- CODE- (SOS/PC/S001)**

The duration period of Hospital Training shall be one to two months.

**M. Sc. Pharm. Chem. II<sup>nd</sup> Sem.**

**FORENSIC PHARMACY  
SELF STUDY COURSE: PAPER- CODE- (SOS/PC/S002)**

Historical back ground of drug legislation in India. The Pharmacy Act, The Drugs and Cosmetics Act and Rules. Medicinal and Toilet Preparations (Excise Duties), Act and rules, The Drugs and Magic Remedies (objectionable Advertisements) Act and Rules, The Narcotic Drugs (Prices Control) order, The Patents Act, The Design Act, The Trade Act and Merchandised Marks Act, The Monopolies and Restrictive Trade Practices Act and Rules, The Medical termination of Pregnancy Act and Rules IPR, Procedure for filing the patent.

**BOOKS SUGGESTED**

1. Report of the Drugs Enquiry committee.
2. Bare Acts pertaining to syllabus
3. A textbook of Forensic Pharmacy-Jain N. K.
4. Forensic Pharmacy- Mithal, B.M.

**M.Sc. PHARMACEUTICAL CHEMISTRY- III SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Drug Design	Core	SOS/PC/C013	40	60	51	3	0	0	3
2.	Laboratory –I (Drug Synthesis)	Core	SOS/PC/C014	40	60	51	0	0	3	3
3.	Laboratory-II) Pharmaceutical Technology	Core	SOS/PC/C015	40	60	51	0	0	3	3
4.	Elective	Elective	Code of Elective	40	60	51	3	0	0	3
5.	Elective	Elective	Code of Elective	40	60	51	3	0	0	3
6.	Elective	Elective	Code of Elective	40	60	51	3	0	0	3

**M.Sc. PHARMACEUTICAL CHEMISTRY- ELECTIVE PAPERS FOR THE III SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	General Pharmaceutics	Elective	SOS/PC/E001	40	60	51	3	0	0	3
2.	Pharmacodynami c agents	Elective	SOS/PC/E002	40	60	51	3	0	0	3
3.	Phytopharmaceuti cals and Nutraceuticals	Elective	SOS/PC/E003	40	60	51	3	0	0	3
4.	Computers	Elective	SOS/PC/E004	40	60	51	3	0	0	3
5.	Biostatistics	Elective	SOS/PC/E005	40	60	51	3	0	0	3
6.	Pharmaceutical Biochemistry	Elective	SOS/PC/E006	40	60	51	3	0	0	3

7	Advance Drug Delivery Systems	Elective	SOS/PC/E007	40	60	51	3	0	0	3
8	Spectroscopy	Elective	SOS/PC/E008	40	60	51	3	0	0	3
9	Applied Microbiology and Biotechnology	Elective	SOS/PC/E009	40	60	51	3	0	0	3

**M.Sc. PHARMACEUTICAL CHEMISTRY SELF STUDY COURSE FOR THE III SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Industrial Training	Self Study	SOS/PC/S003	40	60	51	0	3	0	3
2.	Pharmaceutical Industrial Management	Self Study	SOS/PC/S004	40	60	51	0	3	0	3

**Core Credits 09 + Elective Credits 09; Total Credits= 18 + 03 credits of self study.**

**M. Sc. Pharm. Chem. III<sup>rd</sup> Sem.**

## **DRUG DESIGN**

### **CORE COURSE: PAPER- I; CODE- (SOS/PC/C013)**

#### **Unit-I**

Dose response curve, concept of agonist, partial agonist, antagonist, partial antagonist, competitive & none-competitive antagonism. Drug metabolism.

#### **Unit-II**

Specific & non-specific drug action, concept of receptor, drug-receptor interactions. Receptor theories, spare receptor, ion-channels.

#### **Unit-III**

Topography receptors, adrenergic, cholinergic, H1, H2, steroidal, serotonin, diazepam & opiod receptors.

#### **Unit-IV**

Drug metabolism approaches to drug design. Concept of isosterism & bioisosterism, metabolite antagonism, stereochemistry & drug action. Analog design, concept of prodrug.

#### **Unit-V**

Introduction to QSAR. Chemical information computing system in drug discovery. Molecular modeling drug action.

#### **BOOKS SUGGESTED**

1. William O. Foye, Principles of Medicinal Chemistry, 3<sup>rd</sup> ed., Varghese Publishing House, Mumbai, 1989. Jaime N. Delgado & William A. Remers, Wilson and Gisvold's, Text Book of Organic Medicinal and
2. Jaime N. Delgado & William A. Remers, Wilson and Gisvold's, Text Book of Organic Medicinal and Pharmaceutical Chemistry, 9<sup>th</sup> ed. J.B. Lippincott Company, Philadelphia, 1991.
3. Manfred E. Wolff, Burger's medicinal Chemistry and Drug Discovery, Vol. I to V, 5<sup>th</sup> ed., A Wiley-Interscience publication John Wiley & Sons, Inc. (New York), 1995.
4. Kadam & Mahadik, Bothara, Principles of Medicinal Chemistry vol. I & II, 4<sup>th</sup> ed. Nirali Prakash Pune,

**M. Sc. Pharm. Chem. III<sup>rd</sup> Sem.**



## LABORATORY-I DRUG DESIGN

### CORE COURSE; CODE (SOS/PC/C014)

Experiments based on theory paper **SOS/PC/C013**

Exercises based on QSAR

1. Synthesis of Drug \ Drug Intermediates and their purification by column chromatography.
2. UV, IR, <sup>1</sup>HNMR Spectral Analysis of Synthesized compounds

### BOOKS SUGGESTED

1. William O. Foye, Principles of Medicinal Chemistry, 3<sup>rd</sup> ed., Varghese Publishing House, Mumbai, 1989.s
2. Jaime N. Delgado & William A. Remers, Wilson and Gisvold's, Text Book of Organic Medicinal and Pharmaceutical Chemistry, 9<sup>th</sup> ed. J.B. Lippincott Company, Philadelphia, 1991.
3. Manfred E. Wolff, Burger's medicinal Chemistry and Drug Discovery, Vol. I to V, 5<sup>th</sup> ed., A Wiley-Interscience publication John Wiley & Sons, Inc. (New York), 1995.
4. Kadam & Mahadik, Bothara, Principles of Medicinal Chemistry vol. I & II, 4<sup>th</sup> ed. Nirali Prakash Pune, 1997
5. Vogel's Textbook of Practical Organic Chemistry, ELBS
6. Practical Organic Chemistry by Vishnoi

## LABORATORY II; PHARMACEUTICAL TECHNOLOGY

### ELECTIVE COURSES; CODE (SOS/PC/E016)

Based on Elective papers

Preparation, evaluation and packaging of oral solids like tablets and capsules, liquid orals like solution, suspension, emulsion; Eye drops, and semisolids like ointments, creams.

### BOOKS SUGGESTED

1. British Pharmacopoeia
2. E.A.Rawlins- Text Book of pharmaceutics, Bailliere Tindall.
3. G. Gun and S.J. Carter, Cooper & Gunn's Tutorial Pharmacy, Pitman Medical Publishing Co. London.
4. Gilbert S, ,, Banker and Cristopher T.Rhodes- Moder pharmaceutics and Pharmaceutical Sciences Series, M.& D. Inc. , New York.
5. Leon Lachman- The Theory and Practice of Industrial Pharmacey, K.M. Verghease Co. Bombay.
6. Pharmacopoeia of India.

**M. Sc. Pharm. Chem. III Sem.**

**M. Sc. Pharm. Chem. III<sup>rd</sup> sem.**

**GENERAL PHARMACEUTICS**

**ELECTIVE COURSE: PAPER- II; CODE- (SOS/PC/E001)**

**Unit I**

**Extraction Processes:** Infusion, decoction, maceration and percolation processes and preparation involving them.

**Size Reduction:** Objectives , factor affecting, method of size reduction. Construction and working of hammer mill, fluid energy mill, colloid mill.

**Size Separation:** Official standards for powders, sieving methods.

**Unit II**

**Mixing:** Definition, objectives, type of mixtures, types of equipments used in mixing, propeller, turbine paddle, mixer, collide mixer, sigma mixer, arm mixer, tumbler mixer.

**Drying:** Introduction to drying process, study of tray dryer, fluidized bed dryer , vaccume and freeze dryer.

**Unit III**

**Pharmaceutical Literature and Ethics:** Importance of various Pharmacopoeias with special reference to those with are official in India , general introduction to code of Pharmaceuitical ethics.

**BOOKS SUGGESTED**

1. Hand book of Basic Pharmacokinetics-Ritschel, W.A., Drug Intelligence Publication, M. Hamilton, 1977.
2. Fundamentals of Clinical Pharmacokinetics-Wagner, J.C., Drug Intelligence Publication, M. Hamilton, 1975.
3. Remington's Pharmaceutical Sciences-Gennaro A.R., ed., 19<sup>th</sup> Edition, Mack Publishing kco., Easton, PA. 1995.
4. Clinical Pharmacokinetics-Rowland, M, & Tozer, N., 2<sup>nd</sup> edition, Lea & Febiger, Philadelphia, 1989.
5. Pharmacokinetics-Gibaldi M. & Perrier, D., 2<sup>nd</sup> ed., Marcel Dekker, New York, 1982.
6. Pharmacokinetics for the pharmaceutical scientist-Wagner, J.C., Technomic Publishing AG, Switzerland, 1993.
7. Biopharmaceutes and Pharmacokinetics- Notrari, R.E., 2<sup>nd</sup> ed., marcel Dekker, New York, 1975.

**M. Sc. Pharm. Chem. III<sup>rd</sup> Sem.**

## PHARMACODYNAMICS AGENTS

### ELECTIVE COURSE: PAPER- III; CODE- (SOS/PC/E002)

Study of chemistry, SAR & mechanism of following Classes of Drugs.

#### Unit-I

Drug acting on CVS-Antihypertensive, antiarrhythmic, antianginal, antilipidemic agents. & diuretics.

#### Unit-II

Analgesics, narcotics and Nonnarcotics antipyretics, anti-inflammatory, antigout drugs, NSAID.

#### Unit-III

Drugs acting on CNS-Hypnotics & sedatives, general anaesthetics, antiepileptics.

#### Unit-IV

Psychotropic agents, antidepressants, antiparkinsonian agents, hypoglycaemic drugs, antithyroid drugs.

#### Unit-V

Antihistamines H1, and H2 antagonists, antiserotonins.

Carbohydrate based drugs, oligonucleotides.

#### BOOKS SUGGESTED

1. William O. Foye, Principles of Medicinal Chemistry, 3<sup>rd</sup> ed., Varghese Publishing House, Mumbai, 1989.
2. Jaime N. Delgado & William A. Remers, Wilson and Gisvold's, Text Book of Organic Medicinal and Pharmaceutical Chemistry, 9<sup>th</sup> ed. J.B. Lippincott Company, Philadelphia, 1991.
3. Manfred E. Wolff, Burger's medicinal Chemistry and Drug Discovery, Vol. I to V, 5<sup>th</sup> ed., A Wiley-Interscience publication John Wiley & Sons, Inc. (New York), 1995.
4. Kadam & Mahadik, Bothara, Principles of Medicinal Chemistry vol. I & II, 4<sup>th</sup> ed. Nirali Prakash Pune, 1997

M. Sc. Pharm. Chem. III<sup>rd</sup> Sem.

## **PHYTOPHARMACEUTICALS AND NUTRACEUTICALS**

### **CORE COURSE: PAPER- IV; CODE- (SOS/PC/E003)**

#### **Unit I**

Introduction Definition, historical background present status and future scope of Phytopharmaceuticals.

#### **Unit II**

Classification of crude drug: Alphabetical, morphological, pharmacological and chemical classification.

#### **Unit III**

Adulteration and evaluation of drugs: Causes and types of Adulteration organoleptic, biological, chemical and physical methods of evaluation.

#### **Unit IV**

General principle of formulation of primary and secondary plant metabolites. Biogenesis of carbohydrates, lipids, volatile oils and resins.

#### **Unit V**

Plants and their environmental factors influencing the variability in drug activity

#### **Unit VI**

General introduction and uses of Nutraceuticals.

#### **Unit VI**

An introduction to tissue culture and its scope in production of phytopharmaceuticals

### **BOOKS SUGGESTED**

1. Pharmacognosy: Trease and Evans
2. Pharmacognosy C. K Kokate
3. Pharmacognosy: Wills
4. Pharmacognosy Handa
5. Evaluation of phyto pharmaceuticals : Turner

**M. Sc. Pharm. Chem. III<sup>rd</sup> Sem.**

## **COMPUTERS**

### **ELECTIVE COURSE: PAPER- V; CODE- (SOS/PC/E004)**

#### **Unit I**

##### **History of computer**

Simple model of computer and its working, input-output devices, computer languages and their hierarchy(low level and high level),Introduction of microcomputers, concept of operating system, computer networking, concept of OSI layers, Introduction of software(MS-Word, MS-Excel & Power point etc.)

#### **Unit II**

##### **Introduction of C++ Programming**

Difference between C and C++, concept of OOP'S, basic data types and operators, sample programs, conditional statements(IF-ELSE ,NESTED IF),concept of looping(for, while and do-while),Introduction to arrays(single and double), class and objects, function & function overloading, constructor and destructor, file handling.

#### **UNIT III**

Internet and its working,Uniform resource locator(URL),World wide web,HTTP,Internet explorer,PDB,NRL-3D,BLAST & FASTA,Special software to align sequences,general DNA sequence data base,protein structure data base,genome project database,human mapping data base.

#### **BOOKS SUGGESTED**

- 1.Information technology-D.P.Curtin,Tata McGraw Hill,New Delhi.
- 2.Guide to Medical Informatics,The Internet & Telemedicine-E Coiera,Arnold Publishers,USA.

## **BIOSTATISTICS**

**ELECTIVE COURSE: PAPER- VI; CODE- (SOS/PC/E005)**

### **Unit I**

#### **Introduction and scope of Biostatistics**

Presentation of data: classification of data, Methods of collection of data, frequency distribution, graphical representation of data by histogram, frequency polygon, frequency curve and cumulative frequency curve.

Central tendency and measures of dispersion, mean, median, mode and their properties, partition value, standard deviation and coefficient of variation, simple correlation coefficient and regression coefficient, regression lines, tests of significance :t-test, z-test, chi-square tests, F-test, heterogeneity and independence of attributes.

### **Unit II**

#### **Testing of hypothesis**

Types of errors, power of test, test of significance based on normal distribution T-test for mean of population, difference of means of two normal population, chi-square test of goodness of fit, independent test ,test of variance of normal population F-test for variance ration, correlation and regression ,least square methods and its application, significance of coefficient of correlation, rank correlation curve fitting and sign test.

#### **BOOKS SUGGESTED**

- 1..Biostatistics-Arora & Malhan,Himalaya Publishing House,Bombay.
- 2.Statistical Methods in Biology-Baidy,Cambridge University press.

**M. Sc. Pharm. Chem. III<sup>rd</sup> sem.**

## PHARMACEUTICAL BIOCHEMISTRY

### ELECTIVE COURSE: PAPER- VII; CODE- (SOS/PC/E006)

#### Unit-I

Enzyme, enzyme kinetics, enzyme action, biological oxidation & reduction.

#### Unit-II

Energy metabolism, bioenergetics, Introduction to Intermediary metabolism, carbohydrate metabolism.

#### Unit-III

Protein & nucleic acid metabolism, lipid metabolism and water and mineral metabolism.

#### Unit-IV

Biosynthesis of protein, transmission & expression of genetic information, DNA genetic role, Structure replication m-RNA & transcription & gene protein relationship & control of gene.

#### Unit-V

Immunoglobulins, structure classification, and their biological role. Vitamins, skeleton structure and their biological role.

#### BOOKS SUGGESTED

1. Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Harper's Biochemistry, 25<sup>th</sup> ed. McGraw Hill health Professions Division, New York, USA, 1998.
2. A.V.S.S. Rama Rao, Text Book of Biochemistry, 6<sup>th</sup> ed., L. K. & S. Publishers, Visakhapatnam, 1991.
3. Melson David L. Lehninger Principles of Biochemistry, 3<sup>rd</sup> ed. Macmillan worth Publishers, N. Y. USA, 2001.
4. Stryer Lubert, Berg Jeremy M., Tymoczko Johan L, Biochemistry, 5<sup>th</sup> ed. W. H. Freeman & Company New York, 2002
5. M. C. Pant, Essentials of Biochemistry, 8<sup>th</sup> ed., Kedar nath Ram Nath & Co. Publishers, Meerut, 1996.
6. E. David Metzler, Carol M. Metzler, David J. Sauke, Biochemistry the chemical reactions of living cells, 2<sup>nd</sup> ed., Har court/Academic Press, New York.

M. Sc. Pharm. Chem. III<sup>rd</sup> sem.

## ADVANCE DRUG DELIVERY

### ELECTIVE COURSE: PAPER- VIII; CODE- (SOS/PC/E007)

#### Unit-I Pre-formulation studies:

- a. Study of physical properties of drug like physical form, particle size, shape, density, wetting, dielectric constant, solubility, dissolution and organoleptic property and their effect on formulation, stability and bioavailability.
- b. Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemization, polymerization etc., and their influence on formulation and stability of products.
- c. Study of pro-drugs in solving problems related to stability, bioavailability and elegance of formulations.

#### Unit-II Stability studies:

Kinetic principles and stability testing, order and reaction rate. ICH guidelines for stability testing. Accelerated stability testing procedures. Stability protocols for various pharmaceutical products.

#### Unit - III Novel Drug Delivery Systems:

Introduction, merits, demerits, and application of following: (Formulation aspect is excluded)

- a. Transdermal drug delivery system (TDDS), Aerosols, Paraneural implants, Ophthalmic inserts, Liposomes,
- b. Targeted drug delivery systems ; micro encapsulation of living cells and tissues.
- c. Externally modulated devices and delivery; iontophoresis and sonophoresis.

#### Unit - IV

##### a. Fundamental Concept of Modified Drug Release :

Definitions of controlled release, sustained release time release drug delivery systems. Pre requisites of drug candidates, various approaches and classification, dose calculation for controlled release.

##### b. Coating of tablets:

Types of coating, film forming materials, formulation of coating solution, equipments for coating, coating process evaluation of coated tablets.

**M. Sc. Pharm. Chem. III<sup>rd</sup> Sem.**



## SPECTROSCOPY

### ELECTIVE COURSE: PAPER- IX; CODE- (SOS/PC/E008)

**Unit I: Electron Spin Resonance Spectroscopy:** Principle and theory, Kramer degeneracy, g factor, electron-nuclear coupling (hyperfine structure), line shape and width, Mc Connell relationship, endor and eldor, electron-electron coupling. Techniques of measurement, application of ESR to organic free radicals and to transitional metal complexes (having and unpaired electron) including biological systems.

**Unit II: Mossbauer Spectroscopy:** Basic principles, spectral parameters and spectrum display. Fine structure, application of the technique to the studies of (1) bonding and structure of  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$  (2)  $\text{Sn}^{2+}$   $\text{Sn}^{4+}$  compounds, detection of oxidation state and in equivalent MB atoms.

**Unit III: Nuclear Magnetic Resonance Spectroscopy:** (a) Chemical shift values for proton to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, carboxylic acids, amines, amides), chemical exchange, effects of deuteration, Karplus curve- variation of coupling constant with dihedral angle. (b) Carbon- 13 NMR spectroscopy: General consideration, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic yl compounds), coupling carbon constants.

**Unit : Mass Spectroscopy:** Principle and theory, fundamental mass equation, ionization methods, odd and even electron ions, base peak, isotopic ions, fragmentation patterns, Mc Lafferty rearrangement and RD cleavage, application of mass spectrometry to the structure elucidation of organic molecules.

**Unit V: Photoelectron spectroscopy:** Basic principle, photoelectric effect, ionization proesses, Koopmann's Theorem, photoelectron spectra or simple molecules, ESCA, chemical information from ESCA, Auger electron spectroscopy-basic idea.

### BOOKS SUGGESTED

1. Robert M. Silverstein, Francis X. Webster, Spectrometric identification of organic compounds, 6<sup>th</sup> ed. John Wiley and Sons-Inc 1998.
2. Comin N. Banwell, Elian M. McCash, Fundamentals of molecular spectroscopy 4<sup>th</sup> ed. Tata McGraw -Hill Publishing Company Limited New Delhi, 1995.
3. A.H. Becket and J.B. Stenlake, Practical Pharmaceutical Chemistry, part- II, 4<sup>th</sup> ed., CBS Publishers & Distributors, New Delhi, 1997.
4. W. Kemp, Organic Spectroscopy, 1<sup>st</sup> ed. ELBS/Macmillan, London, 1975.
5. Physical Method for Chemistry, R.S. Drago, Saunders Company.
6. NMR, NQR, EPR, and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Horwood,
7. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpuch and G.J. Martin, Heyden.
8. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C.
9. Spectroscopic Methods in Organic, D.H. William, I. Fleming, Tata McGraw-Hill.

M. Sc. Pharm. Chem. III<sup>rd</sup> Sem.

## **APPLIED MICROBIOLOGY AND BIOTECHNOLOGY**

### **ELECTIVE COURSE: PAPER- X; CODE- (SOS/PC/E009)**

1. General techniques of microbiology: Preparation and sterilization of media, stains and staining techniques.
2. Classification of microbes: actinomycetes, bacteria, rickettsiae, spirochetes and viruses.
3. Nutrition, cultivation, isolation and identification of bacteria, actinomycetes, fungi, viruses.
4. Control of microbes by physical and chemical methods.
5. Sterilization: Different methods, evaluation of sterilization methods, sterility testing of pharmaceutical products.
6. Antiseptics and disinfectants: Definition, factors affecting disinfectants, dynamics of disinfectants, disinfectants and antiseptics and their evaluation.
7. Microbial attack and host defence, virulence and pathogen city, primary and specific defence mechanism of body, infection and its transmission, interferons.
8. Microbial standardization of antibiotics, vitamins, aminoacids.
9. Study of drugs produced by biotechnology such as Activase, Humulin, Humatrops, Intron
10. A, Monoclate, ORTHOCLONE OKT3, Referon-A, Recombivax HB etc.

### **BOOKS SUGESSTED**

1. G. Gun and S.J. Carter, Cooper & Gunn's Tutorial Pharmacy, Pitman Medical Publishing Co. London.
2. L.M. Prescott, G.P. Garley , D.A. Kelein, Microbiology, W C Brown Publishe, Oxford.
3. Laboratory Manual of Biotechnology-Salle
4. Microbiology – Davis Dulbecco, Eisen.
5. Remington's Pharmaceutical Sciences, Gennaro A.R. Mack Publishing Co., Easton. Pa.,USA.
6. T.D. Brock, M.T. Medigan , Biology of Micro-organism, Prentice Hall, New Jersey USA.
7. W.B. Hugo and A.D. Russell, Pharmaceutical Microbiology , Blackwell Scientific Publication, Oxford.

**M. Sc. Pharm. Chem. III<sup>rd</sup> Sem.**

**SULF STUDY COURSE; CODE (SOS/PC/S003)**

**INDUSTRIAL TRAINING**

The duration period of Industrial Training shall be two months.

**M. Sc. Pharm. Chem. III<sup>rd</sup> Sem.**

**PHARMACEUTICAL INDUSTRIAL MANAGEMENT INCLUDING MARKETING**

**SELF STUDY COURSE; CODE (SOS/PC/S004)**

**Plant location and layout of an industry:** Various factors affecting locational aspects, lay out of building and equipment, product layout vs. process layout, compliance of pollution control measures, Elementary knowledge of Factories Act.

**Production Planning and control:** Scientific purchasing, quality control, problems of productivity, stores organization, location of store, receiving, inspection and issue of materials; control of stores and stocks, stores accounting and records.

**Pharmaceutical Marketing:**

Functions, buying, selling, selling, transportation, storage, finance, feedback information, channels of distribution, wholesale, retail, departmental store, multiple shop and order business.

**Finance:**

Principle of economics with special reference to the laws of demand and supply, demand and supply, demand schedule, demand curves, labour welfare, general principles of insurance and inland and foreign trade, procedure of exporting and importing goods.

**Accountancy**

Principle of account, ledger posting and journal entries, preparation of trial balance, column of a cash book. Bank reconciliation statement, rectification of error, profit and loss account, balance sheet, purchase, keeping and pricing of stocks, treatment of cheques, bills of exchange, promissory notes and hundies, documentary

**BOOKS SUGGESTED**

1. Principle and Practice of Management- Peter Drucker.
2. Principles of Management- Koontz o'Donnel.
3. Business Organization and Management- Sukla.
4. Business Organization-Ghose.
5. Principles of Industrial Organization- Kimbell and Kimbell.
6. DoubleEntry Book Keeping-Batliboi.
7. Professional Pharmacy- Jain and Sharma.
8. Factories Act.

### M.Sc. PHARMACEUTICAL CHEMISTRY- IV SEMESTER

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Project from parent institute/industry /Research Organizations. Project should be completed under the guidance of a faculty member in the same Department or Industry or research organization. In case of Industry / research organization one member of that body can also be included as project guide.	Core	SOS/PC/C016	40	60	51	0	0	9	9
2.	Elective	Elective	Code of Elective	40	60	51	3	0	0	3
3	Elective	Elective	Code of Elective	40	60	51	3	0	0	3

4	Laboratory course	Elective	Code of Elective	40	60	51	0	0	3	3
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**M.Sc. PHARMACEUTICAL CHEMISTRY- ELECTIVE PAPERS FOR THE IV SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Herbal Drug Technology	Elective	SOS/PC/E010	40	60	51	3	0	0	3
2.	Advance organic Chemistry	Elective	SOS/PC/E011	40	60	51	3	0	0	3
3.	Drug regulatory Affairs	Elective	SOS/PC/E012	40	60	51	3	0	0	3
4.	Essential of Traditional Medicine	Elective	SOS/PC/E013	40	60	51	3	0	0	3
5.	Cosmeticology	Elective	SOS/PC/E014	40	60	51	3	0	0	3
6.	Laboratory I (Herbal Drug Technology)	Elective	SOS/PC/E015	40	60	51	0	0	3	3
7.	Laboratory II (Pharmaceutical rug Analysis)	Elective	SOS/PC/E016	40	60	51	0	0	3	3
8.	Laboratory II (Cosmetics Evaluation)	Elective	SOS/PC/E017	40	60	51	0	0	3	3

**M.Sc. PHARMACEUTICAL CHEMISTRY SELF STUDY COURSE FOR THE IV SEMESTER**

S. No	Subject Title	Category	Course code	Maximum Marks 100			L	T	P	Credits
				Internal	External	Minimum				
1.	Traditional Healthcare system of Uttarakhand including Ayurvedic Medicines	Self Study	SOS/PC/S003	40	60	51	0	3	0	3
2.	Nanotechnology	Self Study	SOS/PC/S004	40	60	51	0	3	0	3

**Core Credits 09 + Elective Credits 09; Total Credits= 18 + 03 Credits of Self Study**

**M. Sc. Pharm. Chem. IV Sem.****PROJECT****CORE COURSE; CODE (SOS/PC/C016)**

Project from parent institute/industry/Research Organizations. Project should be completed under the guidance of a faculty member in the same Department or Industry or research organization. In case of Industry / research organization one member of that body can also be included as project guide.

1. The project shall be submitted in the Department.
2. Pre submission presentation is compulsory; pre-presentation should be done in the presence of staff members of the department

**M. Sc. Pharm. Chem. IV Sem.****HERBAL DRUG TECHNOLOGY****ELECTIVE COURSE: PAPER- I; CODE- (SOS/PC/E010)**

1. Definition of Herbal drugs, Importance of Herbal therapies, Herbal verses Conventional drugs, Safety in Herbal drugs, Toxicity in Herbals and interaction.
2. Herbals used as nutraceuticals or healing agents.
3. Herbal cosmetics.

4. Making and using Herbal medicines for common ailments like cold, skin infection and diarrhea.
5. Analytical profiles of selected herbs- *Brahmi*, *Arandrographis paniculeta*, *Aegle marmelos* and *Gymnema sylvestre*
6. Quality control and quality Assurance of Herbal drugs.

#### **BOOKS SUGGESTED**

1. Quality Control of Herbal Drugs; Pulok K. Mukharjee
2. Pharmacognosy – C.K.Kokate
3. Quality Control Methods for Medicinal Plant material by WHO, Geneva.
4. Indian Herbal Pharmacopeia Vol. I & II.
5. Trease and Evan's Pharmacognosy 15 edition.
6. Botanical safety hand book by Michael Meguffin, Christopher Hobbs Published by American Herbal Product Asso

**ADVANCED ORGANIC CHEMISTRY**

**ELECTIVE COURSE: PAPER-II; CODE- (SOS/PC/E011)**

**UNIT-1. REACTION INTERMEDIATES:**

Structure, formation, stereochemistry and stability of Carbocation, Carbanions, free radicals, carbene, and nitrene. Mechanism involving free radical, nucleophil & electrophil mediated reactions and methods of determining them.

**UNIT-2. ALIPHATIC NUCLEOPHILIC SUBSTITUTION**

$S_N1$ ,  $S_N2$  and mixed  $S_N1$  and  $S_N2$  mechanism and stereochemical aspects. The neighbouring group mechanism, neighbouring group participation (by  $\pi$ - and  $\sigma$  bonds). Reactivity effects of substrate structure, attacking nucleophilic group, leaving group and reaction medium, ambident nucleophile.

**UNIT-3. ADDITION TO CARBON-CARBON MULTIPLE BONDS**

Mechanism and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

**UNIT-4. ADDITION TO CARBON-HETERO MULTIPLE BONDS**

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Mechanism of condensation reactions involving enolates- Knoevenagel, Claisen, Mannich Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

**Recommended Books:**

1. Advanced Organic Chemistry- Reaction, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.



**DRUG REGULATORY AFFAIRS**

**ELECTIVE COURSE: PAPER- III; CODE- (SOS/PC/E012)**

**UNIT-1. Pharmaceutical legislations in India:** Origin, development, scope, objectives and nature of Pharmaceutical legislation in India.

**UNIT-2. Regulatory Guidelines:** ICH Guidelines & ISO 9000 series, International Regulatory Agencies (USFDA, MHRA, TGA, ANVISA)

**UNIT-3. Laws Governing Pharmaceutical Regulatory Affairs:** Regulatory aspects that affect drug product design, manufacture and distribution in India with special emphasis on the detailed study of the following Acts / Laws (with latest amendments)

- The Drugs and Cosmetics Act, 1940 and Rules there under.
- The Narcotics Drugs and Psychotropic Substances Act.
- Drugs (Price Control) Order in force.
- Copy Right Act, Trade Mark Act, and Biodiversity Act , Factory's Act
- The Environmental Protection Act , Consumer Protection Act

**UNIT-4. Globalization of drug industries:** Export Import Policy of drugs, WHO –certification, Trademarks and copyrights.

**UNIT-5. Documentation:** Product development stage documentation (BPR, BMR, Dossier formation), factory procedures – Standard operating procedures (SOPs) and standard test Procedures (STPs). & validation and calibration protocols.

**BOOKS SUGGESTED**

1. Drugs and Cosmetics Act, 1940 and its rules, published by Ministry of health and family welfare, Government of India.
2. Pharmaceutical Jurisprudence, G.K. Jani.
3. The Pharmaceutical Regulatory Process, 2nd ed. – Ira R. Berry, Robert P. Martin.
4. Medical Product Regulatory Affairs: Pharmaceutical , Diagnostics, Medical Devices – John J. Tobin and Gary Walsh.
5. Good Drug Regulatory Practices: a Regulatory Affairs Quality Manual (Good Drug Development Series) – Helene I. Dumitriu.
6. Pharmaceutical Patent Law – John R. Thomas.
7. Original laws published by Govt. of India.

**ESSENTIAL OF TRADITIONAL MEDICINE**

**ELECTIVE COURSE: PAPER- IV; CODE- (SOS/PC/E013)**

1. Definition, History and scope of Phytomedicines.
2. Alternative system of medicine: Historical overview of Indian system of medicine-Ayurveda, Siddha, Homeopathic system of medicine, Development of Traditional system of medicine in India. Prospects of Traditional medicine.
3. Herbal Remedies- Toxicity and Regulation: Importance of Herbal Therapies. Herbs versus conventional drugs. Efficacy of Herbal medicine. Validation of herbal therapies. Safety in herbal drugs. Toxicity in herbal and their interaction. General concept of evaluation and quality control Assessment by drug Regulations. Herbal drug regulation in India.
4. Phytoconstituents and their Analysis: Introduction, Importance of Phytoconstituents in therapy, qualitative analysis of crude drug extract and isolates. Analysis of alkaloids, volatile oils, fixed oils , fats and waxes, Flavonoids, Terpenoides, Resins, Tannins, Glycosides and Steroids.
5. Extraction of Herbal drugs: Introduction, Basic principles, Pre-extraction operations for crude drug, Effect of solvent, solvent mixtures and solution on extraction, Characteristics of Phytoconstituents, Procedure for extraction of Herbal drugs Extraction methods for specific phytochemical group, treatment of drug residue after extraction.

**BOOKS SUGGESTED**

1. Quality Control of Herbal Drugs; Pulok K. Mukharjee
2. Pharmacognosy – C.K.Kokate
3. Quality Control Methods for Medicinal Plant material by WHO, Geneva.
4. Indian Herbal Pharmacopeia Vol. I & II.
5. Trease and Evan's Pharmacognosy 15 edition.
6. Botanical safety hand book by Michael Meguffin, Christopher Hobbs Published by American Herbal Product Association.
7. Pharmacognosy and pharmacobiotechnology by Ashutosh Kar.

**COSMETICOLOGY**

**ELECTIVE COURSE: PAPER- V; CODE- (SOS/PC/E014)**

1. Physiological consideration: skin, hair, nail and eye in relation to cosmetic application.
2. Rheology of cosmetics: Rheological additives in cosmetics, Rheology of nail products, antiperspirants, deodorants, dentifrices, hair products, creams and lotions.
3. Manufacturing techniques: cosmetics creams, powders, compacts, sticks, liquids, foam and aerosol cosmetics.
4. Evaluation of cosmetics: Performance, physiological, microbiological and psychometric evaluation of cosmetic. Design and assessment of preservative systems for cosmetics, Evaluation of preservatives in cosmetic products, and factors affecting activity of preservatives. Testing of moisturizers, deodorants, antiperspirants, sunscreen and anti-aging products.
5. Clinical safety testing: Irritation, sensitization, photo irritation, photo-allergy, ocular irritation and protocols for the same.
6. Regulatory requirements: Manufacturing and sale of cosmetics.
7. Herbal cosmetics: Formulation developments.
8. Packaging: Package development and design for cosmetic including aerosol packs.
9. Advances in cosmetics: Liposomes, multiple and micromulsions, tooth pastes, hair waving, hair planting, permanent hair coloration, cosmetic surgery, contact lenses.

**BOOKS SUGGESTED**

1. C.G.Gebelein, T.C. Cheng and V.C. Yang; Cosmetic and Pharmaceutical applications of polymer; plenum.
2. Dr. Laba, Rheological properties of cosmetics and toiletries, Marcel Dekker.
3. E.G.Thomsson ; Modern Cosmetics; Universal Publishing Corporation.
4. H. R. Moskowitz; Cosmetic Product Testing; Marcel Dekker.
5. J Knolton and S Rearce; Handbook of cosmetic sciences and technology ; Elsevier science publisher.
6. J. B. Wilkinson and RJ Moore; Harry's cosmetology; Longman, J. Science and Technical.
7. L. Appell; The formulation and preparation of cosmetics, fragrances and flavours; Micelle Press.
8. M.S. Balsom and E. Sagarin; Cosmetic Science and Technology; John Wiley and Sons.
9. R. L. Elder; Cosmetic Ingredients, their safety assessment, Pathotox.
10. S.N.Katju, Law of Drugs; Law publishers (India) Pvt. Ltd.
11. W,C.Waggoner, Clinical safety and efficacy testing of cosmetics; Marcel Dekker
12. W. A. Poucher; Poucher's perfumes, cosmetics and soaps ; Vol. 3, Chapman and Hall

## **LABORATORY I ; HERBAL DRUG TECHNOLOGY**

### **ELECTIVE COURSES; CODE (SOS/PC/E015)**

Based on Elective papers

1. Qualitative analysis of crude drug: Analysis of alkaloids, volatile oils, fixed oils , fats and waxes, Flavonoids, Terpenoides, Resins, Tannins, Glycosides and Steroids.
2. Extraction of Herbal drugs: Procedure for extraction of Herbal drugs Extraction methods for specific phytochemical group, treatment of drug residue after extraction.
3. Application of TLC and Paper Chromatographic Methods in qualitative analysis of crude drug.

### **BOOKS SUGGESTED**

1. Quality Control of Herbal Drugs; Pulok K. Mukharjee
2. Pharmacognosy – C.K.Kokate
3. Quality Control Methods for Medicinal Plant material by WHO, Geneva.
4. Indian Herbal Pharmacopeia Vol. I & II.
5. Trease and Evan's Pharmacognosy 15 edition.
6. Botanical safety hand book by Michael Meguffin, Christopher Hobbs Published by American Herbal Product Association.
7. Pharmacognosy and pharmacobiotechnology by Ashutosh Kar.

## **PHARMACEUTICAL DRUG ANALYSIS**

### **ELECTIVE COURSE; CODE ((SOS/PC/E016)**

1. The laboratory shall constitute analysis of dosage form, typical pharmacopial assays, including disintegration time, dissolution rate, friability etc.
2. Analysis of complex drug formulation. Analysis using Spectrophotometer.

### **BOOKS SUGGESTED**

1. A. H. Becket and J. B. Stenlake, Practical Pharmaceutical Chemistry, Part I, 4<sup>th</sup> ed., CBS Publishers & Distributors, New Delhi, 1997.
2. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney Vogel's Text Book of Quantitative Chemical Analysis 5<sup>th</sup> ed., ELBS, U.K., 1989
3. A. Keneth & A. Connors, A Text Book of Pharmaceutical Analysis, 3<sup>rd</sup> ed., Wiley Interscience Singapore, 1982
4. Pharmaceutical Analysis by J.Higuchi and E.B. Hansen, Interscience Publisher John Willey and Sons , New Yark, London, Sydney

**M. Sc. Pharm. Chem. IV Sem.**

## **LABORATORY III COSMETICS EVALUATION**

### **ELECTIVE COURSE; CODE- (SOS/PC/C017)**

Based on Elective papers

1. Manufacturing techniques: cosmetics creams, powders, compacts, sticks ,liquids, foam and aerosol cosmetics.
2. Evaluation of cosmetics: Performance, physiological, microbiological and psychometric evaluation of cosmetic. Design and assessment of preservative systems for cosmetics, Evaluation of preservatives in cosmetic products, and factors affecting activity of preservatives. Testing of moisturizers , deodorants, antiperspirants, sunscreen and anti-aging products.
3. Clinical safety testing: Irritation, sensitization, photo irritation, photo-allergy, ocular irritation and protocols for the same.

#### **BOOKS SUGESSTED**

1. C.G.Gebelein, T.C. Cheng and V.C. Yang; Cosmetic and Pharmaceutical applications of polimer; plenum.
2. Dr. Laba, Rheological properties of cosmetics and toiletries, Marcel Dekker.
3. E.G.Thomsson ; Morder Cosmetics; Universal Publishing Corporation.
4. H. R. Moskowitz; Cosmetic Product Testing; Marcel Dekker.
5. J Knolton and S Rearce; Handbook of cosmetic sciences and technology ; Elsevier science publisher.
6. J. B. Wilkinson and RJ Moore; Harry's cosmetology; Longmr, j. Sscience and Technical.
7. L. Appell; The formulation and preparation of cosmetics, fragrances and flavours; Micelle Press.
8. M.S. Balsom and E. Sagarin; Cosmetic Science and Technology; John Wiley and Sons.
9. R. L. Elder; Cosmetic Ingredients, their safety assessment, Pathotox.
10. S.N.Katju, Law of Drugs; Law publishers (India) Pvt. Ltd.
11. W,C.Waggoner, Clinical safety and efficacy testing of cosmetics; Marcel Dekker
12. W. A. Poucher; Poucher's perfumes, cosmetics and soaps ; Vol. 3, Chapman and Hall

**M. Sc. Pharm. Chem. IV Sem.**

**NANOTECHNOLOGY**

**SELF STUDY COURSE; CODE- (SOS/PC/S005)**

Application of Nanotechnology in pharmaceutical products.

**M. Sc. Pharm. Chem. IV Sem.**

**TRADITIONAL HEALTH CARE SYSTEM OF UTTARAKHAND INCLUDING AYURVEDIC  
MEDICINE**

**SELF STUDY COURSE; CODE- (SOS/PC/S006)**

Study of Indigenous Traditional Drugs Botanical sources, clinical uses, chemical constituents, pharmacological action and authentication of various herbal Drugs.

Introduction to Ayurvedic Dosage Forms Preparation and Standardization of Ayurvedic Preparation such as Asavas, Arishta, Avaleha, Churna..

**BOOKS SUGGESTED**

1. Pharmacognosy: Trease and Evaans
2. Pharmacognosy C. K Kokate
3. Pharmacognosy: Wills
4. Pharmacognosy Handa
5. Evaluation of phyto phrmaceuticals : Turner
6. Indian Materia Media- Nandkarni



