

OSMANIA UNIVERSITY

Faculty of Pharmacy

SCHEME OF INSTRUCTION, EXAMINATION AND EVALUATION

(Effective for Batches Admitted from 2016 – 17 Academic Year Onwards)

Program Code: 881

B. Pharmacy (Third Year)

SEMESTER - V

Course Code	Description	Course Title	Hours/Week			Credits	Marks		Duration of Exam
			L	T	P		Internal	End Exam	
PY.07.881.5.1.T	PS, CORE	Medicinal Chemistry-I	4	0	-	4	30	70	3
PY.07.881.5.2.T	PS, CORE	Pharmaceutical Technology	4	0	-	4	30	70	3
PY.07.881.5.3.T	PS, CORE	Physical Pharmacy - I	4	0	0	4	30	70	3
PY.07.881.5.4.T	PS, FC	Pharmacognosy - I	3	0	0	3	30	70	3
PY.07.881.5.5.T	PS, FC	Pharmacology - I	3	0	0	3	30	70	3
PY.07.881.5.6.P	PS, CORE	Medicinal Chemistry – I Practical	0	0	4	2	30	70	4
PY.07.881.5.7.P	PS, CORE	Pharmaceutical Technology Practical	0	0	4	2	30	70	4
PY.07.881.5.8.P	HS, FC	Pharmacognosy – I Practical	0	0	4	2	30	70	4
			18	0	12	24	240	560	

MEDICINAL CHEMISTRY – I

Subject Code : PY.07.881.5.1.T
Periods/week : 4 credits:4
Nature of Exam: Theory

Sessional : 30
Examination : 70
Exam Duration: 3 Hrs

Unit – I

Basic Considerations of Drug Activity

Physico chemical properties of drug molecules in relation to biological activity - Solubility, lipophilicity, partition-coefficient, Ionization, hydrogen bonding, Chelation, Redox potential and Surface activity. Bioisosterism and Steric features of drugs, drug distribution and protein binding; Introduction to Pro and Soft drug approach in drug design; Drug metabolism and factors affecting on drug metabolism

NOTE: Introduction, definition, nomenclature, chemical classification (other types of classification wherever relevant), structure, synthesis, general mechanism, mode of action (wherever known), SAR including physicochemical and stereo chemical aspects, metabolism and therapeutic uses of the drugs from each category shall be studied for the following units. An outline of synthetic procedure and metabolism of only the drugs, which are official as per Indian pharmacopoeia and British pharmacopoeia and mentioned in brackets against each category.

Unit – II

Adrenergic agents - (Isoproterenol and Salbutamol)

Adrenergic blocking agents - (Prazocin and Atenatol)

Cholinergic drugs and Acetyl Choline esterase inhibitors - (Carbachol, Physostigmine).

Cholinergic blocking agents - (Pyridinium bromide and Dicyclomine HCl)

Ganglionic blocking agents and neuromuscular blocking agents -(Mecamylamine HCl and Pentolinium Tartarate). Skeletal muscle relaxants -Neuromuscular - (meprobromate)

Unit – III

Cardio Vascular Drugs - Anti-hypertensive drugs - (Captopril and Clonidine) Anti-arrhythmic drugs - (Verapamil, Nifedipine and Diltiazem),

Vasodilators - (Isosorbide dinitrate and Dipyridamole)

Anti- hyper lipidemic agents - (Clofibrate and Aterostatin)

Anti-platelet drugs - (Aspirin and Ticlopidine)

Cardio tonic Agents - Synthetic analogs of cardiac glycosides

Unit – IV

Diuretics - (Acetazolamide and Furosemide, Hydrochlorthiazide and Amiloride).

Positive Inotropic Agents (Amrinone)

Hypoglycemic agents - (Tolbutamide and Glyclazide).

Thyroid agents, Anti-thyroid gents -. (Prophylthiouracil)

Immuno suppressants - (Azathioprine) and Immunostimulants -(Levamisole)

Unit – V

Anti-histaminics (H₁ & H₂)-(Diphenhydramine, Chlorpheniramine, Citrizine, Ranitidine).

Proton Pump Initiators (Omeprazole)

Coagulants and Anti-coagulants - (Warfarin)

Examination : One question from each unit with internal choice.

Text Books

- 1. J.H. Block & J.M. Beale (Eds) Wilson and Giswold's Text Book of Organic Medicinal & Pharmaceutical Chemistry, 11th Edn, Lippincott, Raven, Philadelphia, 2004.**
- 2. W.O. Foye, Text Book of Medicinal Chemistry, 5th edn, Lea & Febiger, Philadelphia, 2002.**
- 3. S.N. Pandeya, Text Book of Medicinal Chemistry, 2nd edn, S. G. Pubn, Varanasi, 2003.**

Reference Books

- 1. D. Abraham (Ed) , Burger Medicinal Chemistry and Drug Discovery, Vol.I , 6th edition, John Wiley & Sons, New York, 2003.**
- 2. B.N. Lads, M.G. Mandel and F.I.Way, Fundamentals of drug metabolism & disposition, William & Welking Co, Baltimere.**
- 3. C. Hansch, Comprehensive Medicinal Chemistry, Vol I-VI Elsevier Pergamon Press, Oxford, 1991.**
- 4. Daniel Lednicer, Strategies for Organic Drug Synthesis & Design, John Wiley N.Y., 1998.**
- 5. D. Lednicer , Organic Drug Synthesis, Vol. I-VI, John Wiley N.Y.**

PHARMACEUTICAL TECHNOLOGY

(Pharmaceutics - III)

Subject Code: PY.07.881.5.2.T

Periods/week: 04 credits:4

Nature of Exam: Theory

Sessional : 30

Examination : 70

Exam Duration: 3 Hrs

Unit – I

Formulations

Excipients

Properties and selection, Antioxidants, Preservatives, Colouring agents, Flavouring agents, Sweetening agents, Diluting agents, Vehicles, Surfactants, Hydrocolloids, Above Adjuvants should be studied with reference to FDA approvals and Drugs & Cosmetics Rules wherever applicable.

Capsules

Hard Gelatin Capsules: Advantages, Sizes, Storage, Printing, Formulation, Selection of sizes, Filling, Sealing, Cleaning and Polishing, Evaluation.

Soft Gelatin Capsules: Advantages, Applications, Formulation, Manufacture & Evaluation.

Unit – II

Suspensions and Emulsions

Suspensions: Formulation Types; Defflocculated and Flocculated suspensions, Formulation parameters; Methods of Manufacture and Evaluation.

Emulsions: Formulation Types, Formulation-parameters, Manufacturing Methods and Selection of equipment, Evaluation methods including the shelf life, Concepts of Multiple emulsions.

Unit – III

Tablets and Tablet Coating

Tablets: Types & Classes, Advantages and Disadvantages, Challenges in formulation and manufacture, Excipients in the formulation, Ideal requirements of Excipients, Granulation methods, Compression Machines, Processing problems in compression - Capping & Lamination, Picking & Sticking, Mottling, Weight variation, Hardness variation etc. Evaluation of Tablets.

Tablet Coating: Coating principles, General equipment, Sugar coating-steps, Compression coating, Film coating-steps, materials used in film coating, enteric coating, Film defects, Specialised coating techniques and Quality Control of Tablets

Unit – IV

Parenterals and Ophthalmic Preparations

Parenterals: Definition, Classification and Types of Parenterals, Advantages and limitations, Preparation, Formulation, Containers, Production procedures & facilities, Environmental and other controls, Filling procedures, Products requiring Sterile Packing, Evaluation tests, Sterile powders, Emulsions, Suspensions.

Ophthalmic Preparations: Requirements of Eye ointments, Eye drops, Formulation,

Methods of preparation, containers, Evaluation and quality control.

Unit – V

Aerosols and Packaging Materials

Aerosols: Definition, Types, Advantages and Disadvantages; Propellants, General Formulation, Manufacturing and packing methods - Pharmaceutical Applications.

Packaging Materials: Glass, Plastics, Metal and Rubber, their influence on dosage form stability.

Examination: One question from each unit with internal choice.

Text Books

- 1. L. Lachman, H.A. Lieberman and J.L. Kanig, Theory and Practice of Industrial Pharmacy, Varghese Publishing House, Mumbai, 3rd Edn, 1991.**
- 2. Ansel's Pharmaceutical dosage forms and Drug delivery systems, 8th edn, 2004, Lippincott Williams & Wilkins, USA.**
- 3. Micheal E Aulton, Pharmaceutics – The science of dosage form design, 1st edition, 1998, Churchill living stone.**

Reference Books

- 1. A.R. Gennaro, Remington: The Science and Practice of Pharmacy, 20th Edition, Vol. 1, Lippincott Williams & Wilins, Philadelphia, 2004.**
- 2. E.A. Rawlins, Bentley's Textbook of Pharmaceutics, 8th Edition, Baillere Tindill, London, 2002.**
- 3. The Prevention of Food Adulteration Act 1954 with Rules.**
- 4. Vijay Malik Drugs & Cosmetic Act 1940, 10th edition.**

PHYSICAL PHARMACY – I

Subject Code : PY.07.881.5.3.T

Periods / Week: 4 credits:4

Nature of Exam: Theory

Hrs

Sessional : 30

Examination : 70

Exam Duration: 3

Unit – I

States of Matter and Phase Equilibria

Gaseous state: Ideal Gas law, Molecular Weight determination, Kinetic Molecular Theory and Vander-waals Equation for Real Gases;

Liquid state: Liquefaction of Gase, Methods of Achieving Liquefaction, Vapor pressure of Liquids, Boiling Point and Heat of Vaporization including Clausius – Claypeyron equation;

Solids and Crystalline state: Crystalline Solids --- X-ray diffraction, melting point and heat of fusion, Intermolecular forces, Polymorphism. Amorphous solids and Liquid crystalline state.

Phase equilibria: The phase rule; Systems containing one, two and three components, Rules relating to Triangular Diagrams; Solid dispersions;

Thermal Analysis: Differential scanning Calorimetry; Differential thermal analysis and Thermogravimetric and Thermochemical Analysis;

Physical properties of drug molecules: Refractive index & Molar refraction

Unit – II

Thermodynamics

Definition of Thermodynamic Terms: Specific Heat, Sensible Heat, Latent Heat and Heats of Transition; Laws of Conservation of Energy; Meaning of Energy Balance and its importance and Inputs of Energy balance; Concept of Heat and Work;

First Law of Thermodynamics: Statement, Definition of Internal Energy, Enthalpy and Heat Capacity; Heat Capacities at constant Volume and Pressure and their relationship;

Thermochemistry: Standard State Heats of Formation and Combustion; Standard Enthalpy of Formation – Hess's Law of Heat summation and its application; Heat of reaction at constant pressure and at constant volume; Enthalpy of neutralization; Bond dissociation energy and its calculations from thermochemical data;

The second and third laws of thermodynamics: Statements, Definition of Entropy, Free energy and Gibbs Free Energy; Free Energy functions and applications.

Unit – III

Solutions of non-electrolytes: Properties, types of solutions and concentration expressions; Ideal and real solutions; Colligative properties and Mol. Wt. determinations.

Solutions of electrolytes: Arrhenius theory of electrolytic dissociation; Modern theory of strong electrolytes; Debye- Huckel theory; Coefficients for expressing colligative properties – L value, Osmotic Coefficient and Osmolality.

Ionic equilibria: Acid-base equilibria – Ionisation of weak acids, weak bases, water and ampholytes, Sorensen's pH scale. Acidity constants – effect of ionic strength upon acidity constants, effect of temperature on ionic equilibria. Determination of Acidity constants.

Unit – IV

Buffered and Isotonic solutions: The Buffer equation – Common ion effect and the buffer equation for weak acid and its salt and a weak base and its salt; pH indicators; Factors influencing pH of buffer solutions; Measurement and calculating tonicity and methods of adjusting tonicity and pH; Buffer capacity and its calculations; Van Slyke equation; Influence of concentration on buffer capacity and maximum buffer capacity; Buffers in Pharmaceutical and biological systems – in vivo biologic buffer systems
Drugs as buffers: Pharmaceutical buffers and their preparation, influence of buffer capacity and pH on tissue irritation, stability vs optimum therapeutic response, pH and solubility.

Unit – V

Electro Motive Force and Oxidation-Reduction: Electrochemical cells, Types of Electrodes, measuring the EMF of cells, reference electrodes and standard potentials, electrometric determination of pH and specific ions; Hydrogen and glass electrodes, operation of pH meter, ion selective electrodes, Applications of Oxidation – Reduction Potentials (Redox potentials) in pharmacy.

Catalysis: Definition of Catalysis and Catalyst; Types of Catalyst; Promoters and Inhibitors; Mechanism of Simple Catalytic Reactions; Factors affecting the catalyst and Catalysis;

Examination: One question from each unit with internal choice.

Text Books

1. Martin, J. Swarbrick & A. Cammarata, "Physical Pharmacy" Lea and Febiger, Philadelphia, III Edition, 1983.
2. C.V.S. Subrahmanyam, Essentials of Physical Pharmacy, Vallabh Prakashan, Delhi, 2005
3. Hougen and Watson k.M & Ragatz r.A, Chemical Process principles, Part-I (Material and Energy Balances), 2nd Edition, New Age International

Reference Books

1. Physical Pharmaceutics, by Shotton & Ridgway, Oxford press, London.
2. A Text Book of Physical Chemistry, by S. Glasstone, Van Nostrand, New Delhi.
3. Physical Chemistry by Walter Moore.
4. Remington's Pharmaceuticals Sciences, ed A.R. Gennaro, Mack Publishing co., PA.
5. Basic principles and calculations in Chemical engineering by D.M Himmelblau, Prentice Hall Publications

PHARMACOGNOSY - I

Subject code : **PY.07.881.5.4.T**
Periods / week : 4 credits:4
Nature of exam: Theory

Sessional : 30
Examination : 70
Exam Duration: 3 Hrs

Unit – I

Introduction to pharmacognosy, methods of classification of crude drugs. Systematic description and storage of crude drugs. Plant hormones and their applications

Cultivation - Advantages and disadvantages of obtaining drugs from cultivated and wild Plants. Variability of drug constituents due to exogenous and endogenous factors like altitude, light, temperature, rainfall, propagation by seeds, vegetative means, selection, mutation, hybridization and polyploidy.

Collection of Medicinal Plants - effect of season, time of collection and age of the plant on the quality of active principles. Treatment subsequent to collection - desirable and undesirable changes after collection / drying.

Unit – II

Plant Biosynthesis - Techniques employed in Biosynthetic pathways, precursor - product sequence, competitive feeding, sequential analysis. Study of basic metabolic pathways, Carbohydrate synthesis, Shikimic acid pathway, Isoprenoid biosynthesis.

Unit – III

Hazards - like infestation with spores of micro organisms eggs and steps to prevent the same. Drugs deterioration by non living factors like moisture etc., and steps to prevent deterioration. Adulterations of crude drugs and their detection. Quality control of crude drugs and Phytochemicals. Study of the following methods for evaluation, identity, purity, quality by organoleptic, microscopic, physical, chemical and biological characters; Moisture content determination, determination of foreign organic matters and analysis of volatile oils, quantitative microscopic exercises including lycopodium spore method, leaf constant, crude fibre content.

Unit – IV

Systematic Pharmacognostic study of following drugs

Carbohydrates - Agar, Tragacanth, acacia, starch, isabgol linseed, regenerated carbohydrate fibres, cellulose, alginates and tamarind; Fixed Oils, Fats and Waxes - Chaulmoogroil, neem oil, castor oil, olive oil, bees wax, spermaceti, carnaubawa, theorbroma oil, and lard.

Tannins - Myrobalan, Black catechu, Pale catechu, gal amla and arjuna.

Unit – V

Systemic Pharmacognostic study of the following Fibers: Cotton, Jute, Hemp, Rayon, Wool, silk and Nylon.

Drugs from mineral and animal origin - Kaolin, talc Bentonite, Cod liver oil, Shark liver oil, cantherides, Musk, Honey, and cochineal.

Proteins & Enzyme - Papain, Pepsi Gelatin, Pancreatin

Examination : One question from each unit with internal choice.

Text Books

1. Pharmacognosy by Trease G.T and Evans w.e 12 ed, Baillers Tindall Easboume, UK.
2. Pharmacognosy by e.K.Kokate, A.P.Purohit, S.B.Gokhale, Nirali Prakashan, Pune.

PHARMACOLOGY-I

Subject Code : PY.07.881.5.5.T

Periods / Week : 4 credits:4

Nature of Exam: Theory

Sessional : 30

Examination : 70

Exam Duration: 3 Hrs

Unit – I

General Principles of Pharmacology

Introduction, Nature and sources of drugs, Routes of administration of drugs. Concept of absorption, bioavailability, Drug distribution, Biotransformation and excretion drugs, Biological half-life and its significance. Mechanism of action including drug receptor Interactions and factors influencing them. Dose response relationship.

Unit – II

Pharmacology of Drugs Acting On ANS

Introduction, Transmission, Distribution and Functions of Drugs acting on Autonomic Nervous System: Cholinoceptor - Activating and cholinesterase inhibitory drugs, Cholinoceptor blocking drugs, Adrenoceptor - Activating and other sympathomimetic drugs, Adrenoceptor - Antagonist drugs.

Unit - III

Pharmacology of Drugs Acting On CNS

Introduction, Transmission, Distribution and Functions of Drugs acting on Central Nervous System: CNS Neuro transmitters; CNS Stimulants: Hypnotics and Anxiolytics; Antipsychotic Agents; Anti-epileptic Agents; Anti-depressants and Mood Stabilizers; Local Anesthetics; Analgesics and Non-steroidal anti-inflammatory agents; Pharmacological management of Parkinsonism and other movement disorders;

Unit – IV

Drugs Acting on Cardio Vascular & Respiratory System

General considerations, Pharmacology of drugs used in the treatment of congestive heart failure, Anti-arrythmics, Anti-hypertensives & Anti-hyperlipedemic drugs, Anti-anginals and Vasodilators. Drugs used in the therapy of shock.

Pharmacology of Drugs affecting Respiratory System: Drugs used in the treatment of disorders of Respiratory Function and Bronchial Asthma. Bronchodialators, Antitussives and expectorants

Unit – V

Drugs Acting on Renal and Gastro Intestinal System

Diuretics and anti-diuretics, Water and Electrolytic Balances and pH modifying agents. Pharmacology of purgatives/laxatives, Anti-diarrhoeals, Emetics and Anti-emetics. Drugs used in peptic ulcers.

Examination: One question from each unit with internal choice.

Text Books

- 1. Pharmacology and Pharmacotherapeutics, R.S. Satoskar and S.D. Bhandarker, Popular Prakashan, Mumbai.**
- 2. Pharmacology, H.P. Rang, M.M. Dale & J. M. Ritter : Churchill Livingstone, 4th edition.**
- 3. Basic and Clinical Pharmacology, 9th edition – Bertram. G. Katzung.**

Reference Books

- 1. Essentials of Medical Pharmacology, K.D. Tripathi, J. P. Brothers Medical Publishers.**
- 2. Lewis's Pharmacology, by J. Crossland, Churchill Livingstone.**
- 3. Pharmacological Principles of Medical Practice, by Krantz and Care, Williams and Wilkins co.**
- 4. Goodman and Gilman's, The Pharmacological Basis of Therapeutics. J. G. Hardman and Lee E. Limbard, Mc. Graw Hill, Health professions Division.**

G.Pulla Reddy College of Pharmacy
Hyderabad

MEDICINAL CHEMISTRY – I - PRACTICALS

Scheme of Instruction

Total Duration	: 60 hrs
Periods / Week	: 4
Credits	: 2
Instruction Mode	: Practical
Subject Code	: PY.07.881.5.6.Pl.

Scheme of Examination

Maximum Marks	: 100
Internal Exam	: 30
End Semester	: 70
Exam Duration	: 4 Hrs

Course objectives

To provide and develop students with skills in various synthetic strategies and purification methods. The course also provides hands-on training in the determination of active pharmaceutical ingredients present in the formulations. The importance of partition-coefficient and their experimental determination also included in the course.

Course Outcomes

The students should able to design and adopt the reaction schemes for the synthesis of drugs and drug intermediates. The students should able to understand and adopt purification techniques. The students should able to design the procedure for the estimation of API present in the formulations. The students should able to appreciate the significance of absorption of drugs in bio-phase and determine partition-coefficient (Log P) of drugs.

I Preparation of drugs/ intermediates

- 1 Phenytoin
- 2 Phenothiazine
- 3 Barbiturate
- 4 Nifedipine
- 5 Aspirin
- 6 6-Methyl uracil
- 7 7-Hydroxy - 4-Methyl Coumarin.

II Assay of drugs

- 1 Phenobarbitone
- 2 Ibuprofen
- 3 Aspirin
- 4 Furosemide
- 5 Ascorbic acid

III Determination of Partition coefficient for any two drugs

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

PHARMACEUTICAL TECHNOLOGY PRACTICALS (Pharmaceutics - II)

Subject Code: PY.07.881.5.7.P
Periods/week: 4 credits:2
Nature of Exam: Practical
Hrs

Sessional : 25
Examination : 50
Exam Duration: 4

List of experiments

Minimum 12 experiments of the following shall be conducted.

1. Determination of optimum concentration of suspending agent (tragacanth) required for maximum physical stability of calcium carbonate suspension.
2. Preparation, identification and physical stability evaluation of an emulsion.
3. Manufacture of Tablets sodium bicarbonate tablets IP (500 mg).
4. Manufacture of paracetamol tablets IP (500 mg)
5. Manufacture of ascorbic acid tablets IP (50 mg).
6. Manufacture of aspirin tablets IP (300 mg).
7. Manufacture of calcium lactate tablets IP (300 mg).
8. Evaluation of uncoated marketed tablets (in-process and quality assurance).
9. Evaluation of coated marketed tablets (in process and quality assurance).
10. Manufacture of aspirin hard gelatin capsules USP (300 mg).
11. Evaluation of marketed hard gelatin capsules.
12. Manufacture of ascorbic acid injection IP.
13. Manufacture of calcium gluconate injection IP.
14. Manufacture of nandrolone deconate injection IP.
15. Manufacture of dextrose intravenous infusion IP.
16. Manufacture of Ophthalmic preparation.
17. Preparation of emulsion with combination of emulsifying agents using HLB values concept.
18. Preparation of suspension using suitable suspending agent.
19. Manufacture of declofenac gel.
20. Preparation of Multiple emulsions.

Reference Books 1. Indian Pharmacopoeia, 2nd, 3rd and 4th Editions, The Controller of Publications, Delhi, 1966, 1985 and 1996.

2. British Pharmacopoeia, Office of the British Pharmacopoeial Committee, London, 1988.

3. British Pharmaceutical Codex, 11th and 12th Edns, The Pharmaceutical Press, London, 1994.

4. United States Pharmacopoeia, 23 and National Formulary 18, Asian Edition, US Pharmacopoeial Convention, Inc., New York, 1995.
5. D.P.S. Kohli, Drug Formulation Manual, Eastern Publishers, Delhi, 1991.
6. Hoover, Dispensing of Medication, 8th Edn, Mack Publishing Company, Pennsylvania, 1976.
7. C.V.S Subrahmanyam, J. Thimma Setty and G.C. Prabhu Shankar, Laboratory Manual of Pharmaceutics, Vallabh Publications, New Delhi, 2006.

PHARMACOGNOSY PRACTICALS

Subject Code : PY.07.881.5.8.P
 Periods / Week: 4 credits:2
 Nature of Exam: Practicals

Sessional : 25
 Examination : 50
 Exam Duration: 4 Hrs

List of Experiments

1. Detailed Microscopical study (Transverse section) of following drugs (Any four)
 - (a) Rauwalfia (b) Cinchona (c) Senna (d) Liquolice (c) Fennel (f) Clove (g) Nux-Vomica.
2. Microscopical powder characters of (Any eitht)
 - (a) Vasaka (b) Clove (c) Ephedra (d) Cinnamon (e) Liquorice (f) Digitalis (g) Quassia (h) Nuxvomica (i) Cinchona G) Coriander (k) Senna (l) Kruchi (m) Rauwolfia.
3. Morphological Identification of drugs listed in theory.
4. Determination of swelling factor.
5. Determination of refractive index and optical rotation.
6. Isolation and Identification of starch from potatoes.
7. Isolation and Identification of Caffine from tea
8. Isolation of Tannic acid from Galls.
9. Estimation of cincole in encalyptus oil.
10. Distillation of volatile oils (Demo).
11. Qualitative Microscopical powder Analysis (Binary Mixture).
12. Determination of stomatal index, palaside ratio and number
13. Measurement of fibers and grains

Reference Books

1. K.R Khandelwal, Practical Pharmacognosy, Nirali Prakashan, Pune, 2002.
2. M.A. Iyengar, Study of Crude Drugs, Manipal Press Ltd, Manipal, 2004.
3. M.A. Iyengar, Pharmacognosy of Powder Crude Drugs, Manipal Press Ltd, Manipal, 2005.
4. M.A. Iyengar and S.G.K. Nayak, Anatomy of Crude Drugs, Manipal Press Ltd, Manipal, 2004.
5. C.K. Kokate, A.P. Purohit and B. Gokhale, Pharmacognosy, Nirali Prakashan, Pune, 2006.

6. Vinod D. Rangan, Pharmacognosy & Phylochemistry, Career Publication, Nashik, 2008.
7. Ashistosh Kar, Pharmacognosy & Phannacobiotechnology, New Age International Publishers, New Delhi, 2003.

Library
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