

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

II Year B. Pharmacy II-Semester

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3+1*	0	3

(R9301) PHARMACEUTICAL UNIT OPERATIONS II

UNIT-I

Heat Transfer: Source of heat, heat transfer, steam and electricity as heating media, determination of requirement of amount of steam/electrical energy, steam pressure, boiler capacity, mathematical problems on heat transfer.

UNIT-II

Evaporation: Basic concept of phase equilibria, factors affecting the evaporation, evaporators, film evaporators, and single effect evaporators.

UNIT-III

Distillation: Raoult's law, phase diagrams, volatility, simple steam and flash distillations, principles of rectification, Azeotropic and extractive distillation.

UNIT-IV

Drying: Moisture content and mechanism of drying, rate of drying and time of drying calculations, classification and types of dryers, dryers used in pharmaceutical industries tray dryer, Fluid bed dryer, spray dryer and freeze-dryer.

UNIT-V

Size Reduction: Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of a mill, types of mills including ball mill, hammer mill and fluid energy mill.

UNIT-VI

Size Separation : Official standards for powders, sieves, modes of motion in size separation. Sieve Analysis Testing of powders. Equipment for size separation.

UNIT-VII

Mixing: Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing equipment, double cone, twin-shell, silverson mixer, colloid mill, sigma blade mixer, planetary mixer, propeller mixer and turbine mixer.

UNIT-VIII

Automated process control systems: Elements of automatic process control and introduction to automatic process control systems. Elements of computer aided manufacturing (CAM). Reactors and fundamentals of reactors design for chemical reactions.

TEXT BOOKS

1. S.J. Carter, Cooper and Gunn's Tutorial Pharmacy, 6th ed., CBS publisher, Delhi.
2. CVS Subhramanyam, Pharmaceutical Engineering.
3. K. Samba Murthy, Pharmaceutical Engineering
4. Mc Cabe & Smidth, Unit Operations.

REFERENCE BOOKS

1. W.I. Macebe and J. C. Smith Macro, Unit Operations To Chemical Engineering, Hill Int. Book Co., London.
2. L. Lachman, H. Lieberman & J. L. Kaniz, The Theory And Practice Of Industrial Pharmacy, Lee & Febiger Philadelphia, USA
3. Badzer & Banchoro, Introduction to Chemical Engineering.
4. Perry's Handbook of Chemical Engineering
5. M.E. Aulton, Pharmaceutics- The science of dosage form design, 2nd ed.
6. E.A. Rawlin's, Bentley's Text Book of Pharmaceutics, 8th ed ELBS

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II Year B. Pharmacy II-Semester

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(R9302) PHARMACEUTICAL ANALYSIS I

UNIT-I

Computation of analytical results, significant figures, concept of error, precision, accuracy, standard deviation, rejection of doubtful values with special reference to volumetric analysis.

Calibration of analytical equipment used in volumetric analysis.

UNIT-II

- (a) **Theory of Neutralization Titrations:** Acid-base concept, Acidimetry, Alkalimetry, Common ion effect and solubility product, pH, buffers and indicators.
- (b) General principles and theory of oxidation-reduction methods and precipitation methods. An account of the indicators used in these titrations.
- Application of the above methods in the analysis of drugs, as under IP 2006

UNIT-III

- (a) **Complexometric titration:** Theory, types and application in pharmaceutical analysis. Masking and demasking and their applications.
- (b) **Non-aqueous titration:** Theory, types, solvents used and application in pharmaceutical analysis.

UNIT-IV

- (a) **Potentiometry:** Introduction, electrochemical cells and half cells. Electrode, measurement of potential, applications in pharmaceutical analysis.
- (b) **conductrometric titrations.** Basic concepts, different types of conductrometric titrations, apparatus used, applications in pharmaceutical analysis.

UNIT-V

- (a) **Polarography:** Basic concepts, apparatus and principles, general polarographic analysis, applications in Pharmaceutical Analysis.
- (b) **Amperometric titrations** with one polarized electrode, general procedure, titration curves, applications in pharmaceutical analysis.

UNIT-VI

Flamephotometry: Introduction, study and working principles of instrumentations

used for analysis, applications in pharmaceutical analysis.

UNIT - VII

Study of separations and determinations involving the following techniques and their applications in pharmacy

- a) **Coloumn chromatography :** Adsorption and partition theory, preparation, procedure, methods of detection.
- b) **Thin layer chromatography:** theoretical consideration, preparation, procedure, detection of compounds.
- c) **Paper Chromatography:** theory of partition, different techniques employed filter papers used, quantitative and qualitative detection.

UNIT-VIII

- a) Principle, instrumentation and applications involved in the following
- i. Refractometry
 - ii. Polarimetry
 - iii. Nephelometry and turbidimetry
- b) Physical and chemical methods of determination of moisture content (including Karl-Fisher method).

TEXT BOOKS

1. Kasture & Wadodkar, Text Book of Pharmaceutical analysis Vol.I & II.
2. A. Day Under Wood, Text Book of Quantative Analysis
3. Connors, A Textbook of Pharmaceutical Analysis.
4. B.K. Sarma, Instrumental Chemical Analysis, Goel Publishers.
5. Chatwal & Anand, Instrumental Methods of Analysis.
6. Skoog-Instumental Analysis and Skoog fundamentals of analytical Chemistry

REFERENCES

1. A.H. Beckett & J.B Stanlake Vol.I&II., Practical Pharmaceutical Chemistry, Athlone Press of the Univ of London
2. A.I Vogel, Quantitative Chemical Analysis, ELBS ed.
3. L.M. Atherden, Bentley and Driver's Textbook of Pharmaceutical Chemistry., Oxford University Press, Delhi.
4. Pharmacopoeia (IP, BP, USP).
5. Y.Anjaneyulu, K.Chandrasekhar, Valli Manickam, A Textbook of Analytical Chemistry

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(R9303) PHARMACOGNOSY I

UNIT-I

Definition, history, scope and development of Pharmacognosy.

UNIT-II

Brief introduction to natural sources of drugs with examples: Plant Source, Animal Source, Mineral Source, Marine Source and microorganisms.

UNIT-III

Classification of crude drugs: Alphabetical, morphological, taxonomical and chemical classification with suitable examples.

UNIT-IV

Cultivation, collection, processing, drying and storage of medicinal plants.

- Factors influencing cultivation of medicinal plants.
- Plant hormones and their applications.
- Definitions and examples for polyploidy, mutation and hybridization with reference to medicinal plants.

UNIT-V

Good Agriculture Practices: Strategies of obtaining improved cultivations of medicinal plants

UNIT-VI

Systematic pharmacognostic study of the following carbohydrates and derived products: Acacia, tragacanth, agar, starch, guar gum, pectin, isabgol and honey.

UNIT-VII

Systematic Pharmacognostic study of the following Lipids: Castor oil, cod liver oil, shark liver oil, linseed oil, cocoa butter, kokum butter, bees wax, wool fat, hyndocarpus o'l, spremaceti, lard and olive oil.

UNIT-VIII

Systematic Pharmacognostic study of the following volatile oils: Mentha, coriander, cinnamon, lemon oil, nutmeg, eucalyptus, ginger, cardmom, tulsi, lemon grass, caraway, cumin, dill, clove, fennel and black pepper

TEXT BOOKS

1. Kokate C.K, Purohit AP & Gokhale Pharmacognosy S.B (Nirali)
2. Trease and Evans Pharmacognosy, Latest Edition.
3. Tyler, Brady & Robert, Pharmacognosy.
4. T.E.Wallis, Textbook of Pharmacognosy, Pub by CBS Publishers and distributors, New Delhi.

REFERENCES

1. Atal C.R & Kapur B.M, Cultivation & Utilization of Medicinal Plants.
2. Ayurvedic Pharmacopoeia of India, Pub by Govt. of India.
3. A.A. Farooqi & B.S. Sree Ramu, Cultivation of Medicinal and Aromatic Crops, University Press, Hyderabad.
4. CSIR Publications, Wealth of India.
5. Handa and Kapoor, Text Book of Pharmacognosy.
6. Gokhale, Pharmacognosy.
7. Ali, Pharmacognosy.
8. Heinrich, Fundamentals of Pharmacognosy and Phytotherapy.
9. B.P. Pandey, Economic Botany.

(R9304) PHYSICAL PHARMACY - II

UNIT-I

Solubility and Distribution Phenomena: Solvent-solute interaction, solubility of gases in liquids, solubility of liquids in liquids, solubility of solids in liquids, distribution of solutes in immiscible solvents.

Introduction to phenomena of diffusion: Ficks first law and second law.

UNIT-II

Complexation: Types, classification, metal complexes, organic molecular complexes, inclusion complexes, methods of analysis and drug action.

UNIT-III

Kinetics: Rates and orders of the reaction. Influence of temperature and other factors on reaction rates. Decomposition and stabilization of medicinal agents, kinetics in the solid state and accelerated stability analysis (relevant numerical problems).

UNIT-IV

Interfacial Phenomena: Liquid interfaces, measurement of surface and interfacial tensions, adsorption at liquid interfaces. Surface-active agents and HLB scale. Adsorption at solid interfaces. Electrical properties of interfaces.

UNIT-V

Micromeritics: Particle size and size distribution, methods for determining surface area, methods for determining particle size, pore size, particle shape and surface area, derived properties of powders.

UNIT-VI

Rheology: Newtons law of flow, Newtonian systems, non-Newtonian systems, thixotropy, measurement and applications in formulations. Determination of viscosity and its applications.

UNIT-VII

Colloids: Introduction, types of colloidal systems, solubilization, Stability of colloids, optical properties, kinetic properties, electrical properties and Donnan Membran equilibriaum.

UNIT-VIII

Coarse Dispersions: Suspensions : Types of suspensions, interfacial properties of suspended particles, stability evaluation, settling in suspensions, formulation of suspensions.

Emulsions: Theories of emulsification, physical stability of emulsions, preservation of emulsions, rheological properties of emulsions and suspensions.

TEXT BOOKS

1. Patrick J. Sinko, Martin's Physical Pharmacy and Pharmaceutical Sciences 5th Edition.
2. CVS Subramanyam, Physical Pharmacy, Vallabh prakashan.
3. L. Lachman, H. Lieberman The Theory And Practice Of Industrial Pharmacy J. L. Kaniz Lee & Febiger Philadelphia, USA

REFERENCE

1. Lippincott Williams and Wilkins, Remington Pharmaceutical Sciences
2. M.E. Aulton, Pharmaceutics The science of dosage form design, 2nd edition
3. Derle D.V., Essentials of Physical Pharmacy.

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(R9305) ENVIRONMENTAL SCIENCE

UNIT-I:

The **Multidisciplinary nature of environmental studies:**

Definition, scope and importance.

UNIT-II:

Natural Resources:

- Forest resources:** Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- Water resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
- Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies
- Energy resources:** Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources, case studies.
- Land resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

UNIT-III:

Conservation of natural resources: Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT-IV:

Ecosystems: Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystem:

- Forest ecosystem
- Grassland ecosystem,
- Desert ecosystem,
- Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT-V:

Biodiversity and its conservation: Introduction, definition: genetic species and ecosystem diversity.

Biogeographically, classification of India. Value of biodiversity: consumptive use, productive use, and social, ethical, aesthetic and option values, biodiversity at global, national and local levels. India as a mega-diversity nation. Hot spots of biodiversity. Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India.

Conservation of biodiversity: In-situ conservation of biodiversity

UNIT-VI:

Environmental Pollution: Definition, causes, effects and control measures of:

- Air pollution,
- Water pollution,
- Soil pollution,
- Marine pollution,
- Noise pollution,
- Thermal pollution and
- Nuclear hazards.

Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies.

Disaster management: Floods, earthquake, cyclone and landslides.

UNIT-VII:

Social Issues and the Environment: From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management Resettlement and rehabilitation of people; its problems and concerns.

Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear Accidents and holocaust.

Case studies: Wasteland reclamation. Consumerism and waste products.

Unit VIII:

Environment protection Act. The air (prevention and control of pollution) act 1981. The Water (prevention and control of pollution) act 1974. The wildlife protection Act 1972. The Forest conservation Act 1980. Issues involved in enforcement of environmental legislation. Public awareness.

Human population and the Environment

Population growth, variation among nations. Population explosion Family welfare programme. Environment and human health, human rights. Value education. HIV / AIDS, women and child welfare. role of information technology in environment and human health. **Case studies.**

TEXTBOOKS

2. M. Anji Reddy, Text Book of Environmental Sciences & Technology, BS Publications
3. Connar, Basic Concepts of Environmental Chemistry, Lewis Publications.
4. D.K Asthana and Meera, Text book of Environmental studies.
5. Y. Anjaneyulu, Introduction to Environmental Science, B.S. Publication, Hyderabad
6. C. Manohar Chary, P Jayram Reddy, Principles of Environmental Studies, Pharma book syndicate.

REFERENCES

1. William P. Cunningham & Mary Ann Cunningham, Principles of Environmental Science - Inquiry & Applications.
2. W. P. Cooper & et al, Environmental Encyclopedia, Jaico Publishing House, Mumbai.
3. K. C. Agarwal, Environmental Biology, Nidi Publishers Ltd, Bikaner.
4. Environmental Protection and laws, Himalaya Publ House, New Delhi.
5. R.Rajagopalan, Environmental Studies, Oxford University Press.

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(R9306) PHARMACEUTICAL UNIT OPERATIONS II LAB

1. Measurement of flow of fluids and their pressure, determination of reynold's number and calculation of frictional losses.
2. Evaluation of filter media, determination of rate filtration and study of factors affecting filtration including filter aids.
3. Experiments to demonstrate applications of centrifugation.
4. Determination of Humidity-use of Dry Bulb and Wet Bulb thermometers and Psychometric charts.
5. Determination of overall Heat Transfer Coefficient.
6. Determination of rate of evaporation.
7. Experiments based on steam. Extractive and Azeotropic distillations.
8. Determination of rate of drying, free moisture content and bound moisture content.
9. Experiments to illustrate the influence of various parameters on the time of drying.
10. Experiments to illustrate principles of size reduction, Laws governing energy and power requirements of a size reduction.
11. Experiments to illustrate solid-solid mixing, determination of mixing efficiency using different types of mixers.

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(R9307) PHARMACEUTICAL ANALYSIS I LAB

1. Assay of Pharmaceutical compounds based on chemical methods such as acid base, oxidation-reduction, non-aqueous, complexometric titration methods.
2. Conductometric determination of equivalent point of titration of HCl with NaOH.
3. Potentiometric determination of pH of a solution.
4. Potentiometric titration of an Acid.
5. Potentiometric determination of strength of unknown solution and HCl with NaOH.
6. Nephelometric determination of sulfate.
7. Fluorimetric estimation of quinine.
8. Polarographic determination of amount of Nitrobenzene in solutions.
9. Flame photometric determination of Sodium.
10. Flame photometric determination of Potassium.
11. Determination of refractive index of liquids by Abbe refractometer.

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(R9308) PHARMACOGNOSY I LAB

1. Collection of natural herbs and preparation of herbarium/laminated photos for five drugs.
2. Macroscopy, microscopy and chemical tests for any five carbohydrates mentioned in theory.
3. Macroscopy, microscopy and chemical tests for any five lipids mentioned in theory. Identification of crude drugs listed in theory.
4. Macroscopy, microscopy and chemical tests for any five volatile oils mentioned in theory.
5. Cultivation of medicinal plants: Maintenance of one plant in Medicinal garden.

REFERENCES

1. Kandhelwal, Practical Pharmacognosy.
2. C.K. Kokate et.al, Practical Pharmacognosy.
3. Iyengar, Practical Pharmacognosy

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(R9309) PHYSICAL PHARMACY-II LAB

1. Determination of bulk density, true density and percentage porosity.
2. Effect of particle size and effect of glidant on angle of repose.
3. Microscopic size analysis.
4. Determination of particle size by Andreasen Pipette.
5. Determination of CMC of a surfactant.
6. Adsorption Isotherm.
7. Partition coefficient determination.
8. Determination of sedimentation volume and degree of flocculation.
9. Determination of Order of reaction First order.
10. Determination of Second order reaction rate constant.
11. Effect of temperature on solubility of solid in liquid.
12. Effect of addition of Salt/pH/cosolvent on the solubility
13. Surface tension using Stalagmometer.
14. HLB value estimation of surfactants.
15. Viscosity by Ostwald Viscometer.
16. Preparation of Multiple emulsion - Demonstration.
17. Preparation of Micro emulsion - Demonstration.
18. Determination of Zeta potential - Demonstration.