w. e. f. AY 2016-17

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. PHARMACY COURSE STRUCTURE (2016-17)

II YEAR I SEMESTER

S. No	Course Code	Subject	L	T	P	Credits
1	PS301	Pharmaceutical Organic Chemistry – III	4	1	0	4
2	PS302	Pharmaceutical Unit Operations – I	4	1	0	4
3	PS303	Hospital and Community Pharmacy	3	1	0	3
4	PS304	Pharmacognosy – I	3	1	0	3
5	PS305	Pharmaceutical Analysis – I	4	1	0	4
6	PS306	Pharmaceutical Organic Chemistry – III Lab	0	0	3	2
7	PS307	Pharmacognosy – I Lab	0	0	3	2
8	PS308	Pharmaceutical Analysis – I Lab	0	0	3	2
9	*MC309	Environmental Science and Technology	3	0	0	0
		Total	**21**	**5**	**9**	**24**

***MC – Mandatory Course**

PS301: PHARMACEUTICAL ORGANIC CHEMISTRY - III

B. Pharm II Year I Sem

L	T	P	C
4	1	0	4

Course Objectives: The chemistry of highly complicated organic compounds like polynuclear hydrocarbons and heterocyclic compounds are discussed along with their stereochemical aspects

Course Outcome: As the structural and stereochemical aspects and chemistry of organic compounds are discussed, it would help the students to have a good command over structural composition of organic compounds to evaluate and analyze the chemistry of these compounds

Note: Definition, nomenclature, structure, aromaticity, reactivity, acidity-basicity and characteristic reactions of the following heterocyclic compounds.of Unit I and II Few Examples of Drugs which contain the cited ring system.

UNIT - I

Five membered and six membered ring systems with one hetero atom: Furan, pyrrole, thiophene and pyridine.

Fused ring systems with one hetero atom: Indole, quinoline, iso-quinoline, and acridine.

UNIT - II

Five membered and six membered ring systems with two heteroatoms: Pyrazole, imidazole, oxazole, isoxazole, thiazole, pyrazine, pyrimidine and pyridazine.

Fused ring systems with two heteroatoms: Benzimidazole and phenothiazine, Cinnoline, Quinazoline and Quinoxaline.

UNIT - III

Stereochemistry of Carbon compounds: Optical rotation, plane polarized light, optical activity, chirality, notations (assignment of configuration), relative configuration (Fischer DL configuration), absolute configuration (R & S), sequence rules (with examples), enantiomers, meso compounds, racemic mixture, resolution.

Stereochemistry of alkenes*:* Concept of E & Z configurations.Elements of symmetry.

UNIT - IV

a) Polynuclear aromatic hydrocarbons: Nomenclature, structure and aromatic character of naphthalene, anthracene, phenanthrene and naphthacene resonance structures, electron density and reactivity. Electrophilic substitution, oxidation and reduction reactions.

b) Purine derivatives (xanthine bases): Chemical structures of uric acid and methylated xanthines (caffeine, theophylline and theobromine) of physiological/ pharmaceutical significance.

c) Definitions of nucleic Acids, nucleotides, nucleosides, A brief account on structure of DNA & RNA.

UNIT - V

A study of the mechanism and application in synthesis of the following named reactions:

1. Beckmann rearrangement
2. Birch reduction
3. Mannich reaction
4. Michael addition reaction
5. Wittig reaction
6. Lossen rearrangement
7. Curtius rearrangement
8. Schmidt reaction

TEXT BOOKS:

1. R Morrison and R. Boyd, organic chemistry, Pub by Printice Hall of India, New Delhi.
2. I L Finar, Organic Chemistry, Vol. I. & II, 6th Pearson education
3. Reagents & reaction by O.P Agarwal

REFERENCES

1. Jerry March, Advanced Organic Chemistry 4th Ed.
2. Solomons, Organic Chemistry

PS302: PHARMACEUTICAL UNIT OPERATIONS- I

B. Pharm II Year I Sem **L T P C 4 1 0 4**

Course Objectives: The student shall be exposed to various aspects of handling of fluids, application of filtration, centrifugation, crystallization and humidification in pharmaceutical industry.

Course Outcome: Student will understand the concepts of fluid flow, parameter of filtration, centrifugation, crystallization and humidification. They also understand the safety factors and posses a sound knowledge on the above aspects.

UNIT - I

a. Fluid Flow: Types of flow, Reynold's number, viscosity, concept of boundary layer, basic equations of fluid flow, valves, flow meters, manometers and measurement of flow and pressure.

b. Dehumidification and Humidity control

Basic concepts and definition, wet bulb and adiabatic saturation temperature. Psychrometric chart and measurement of humidity, application of humidity measurement in pharmacy, equipments for dehumidification operations.

UNIT - II

Filtration and Centrifugation: Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter, etc. Factors affecting filtration, mathematical problems of filtration, optimum-cleaning cycle in batch filters.

Principles of centrifugation, industrial centrifugal filters, centrifugal filters, and centrifugal sedimeters.

UNIT - III

Crystalization: Characteristics of crystals like; purity, size, shape, geometry, habit, forms, size and factors affecting it. Solubility curves and calculation of yields. Supersaturation theory and its limitations. Nucleation mechanisms, crystal growth. Study of various types of crystallizers such as Swenson walker crystalizer, vacuum crystalizer, crystal crystallizer. Caking of crystals and its prevention. Numerical problems on yields.

UNIT - IV

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

UNIT - V

Industrial hazards and safety precautions: Mechanical, Chemical, Electrical, fire and dust hazards. Industrial dermatities, accident records etc.

TEXT BOOKS

1. S.J. Carter, Cooper and Gunn's Tutorial Pharmacy 6th ed CBS publisher, Delhi.
2. C.V.S. Subramanayam, Pharmaceutial Unit Operation, Vallabh Prakashan
3. Prof. K. Samba Murthy, Pharmaceutical Engineering.

REFERENCES

1. Perry's Handbook of Chemical Engineering.
2. Unit Operations by Mc Cabe & Smith.

PS303: HOSPITAL AND COMMUNITY PHARMACY

B. Pharm II Year I Sem **L T P C 3 1 0 3**

Course Objectives: Upon completion of the course, the student shall be able to –

know various drug distribution methods;

know the professional practice management skills in hospital pharmacies;

provide unbiased drug information to the doctors;

know the manufacturing practices of various formulations in hospital set up;

appreciate the practice based research methods; and

appreciate the stores management and inventory control.

Course Outcome: Student will be familiar with the Hospital pharmacy organization, incompatibilities and patient related factors.

UNIT - I

a) **Organization and Structure**: Organization of hospital and hospital pharmacy. Responsibilities of hospital pharmacist. Pharmacy and Therapeutic committee, Budget preparation and implementation.

b) **Hospital Formulary:** Contents preparation and revision of hospital formulary.

UNIT – II

a) Drug Store Management and Inventory Control
   1. Organisation of drug store, type of materials, stock, storage conditions.
   2. Purchase and Inventory control, principles purchase, procedures, purchase orders, procurement and stocking.

b) Drug Distribution System in Hospitals
   1. Outpatient dispensing – method adopted.
   2. Dispensing of drug to inpatients, Types of drug distribution systems, charging policy, labeling.
   3. Dispensing of drugs to ambulatory patients.
   4. Dispensing of controlled drugs.

UNIT - III

a) Central Sterile Supply Unit and their Management: Types of materials for sterilization, packing of materials prior to sterilization, sterilization equipments supply of sterile materials.

b) Manufacture of Sterile & Non Sterile Products: Policy making of manufacturable items, demand and costing, personnel requirements, manufacturing practice, master formula card, production control, manufacturing records.

UNIT - IV

a) Drug Information Services: Sources of information on drugs, diseases,treatment schedules, procurement of information's, computerized services (e.g. MEDLINE) retrieval of information, medication error.
b) Records and Reports: Prescription filing, drug profile, patient medication

UNIT - V

a) Community Pharmacy-organisation and structure of retail and wholesale drug store-types of drug store, design and legal requirements for establishment, maintenance, dispensing of proprietary products, maintenance of records of retail and wholesale, patient counseling, role of pharmacists in community healthcare and education.
b) Patient compliance-reason for noncompliance pharmacists' role in patients compliance.
c) Responding to common symptoms

TEXT BOOKS: (latest editions)

1. Hospital pharmacy by William .E. Hassan
2. A text book of Hospital Pharmacyby S.H.Merchant & Dr. J.S. Qadry. Revised by R.K.Goyal & R.K. Parikh

REFERENCES

1. Allwood, M.C., Fell, J.T., Text Book of Hospital Pharmacy, Blackwell Scientific Publications, Oxford, UK.
2. Owunwonne, A Handbook of Radio Pharmaceuticals Narosa Publishing House, New Delhi.
3. Diana, M.C., Michael, E.A., Pharmaceutical Practice, ELBS, London.

PS304: PHARMACOGNOSY – I

B. Pharm II Year I Sem

L	T	P	C
3	1	0	3

Course Objectives: To know the medicinal and pharmaceutical importance of drugs obtained from the natural sources and to acquire the knowledge on crude drugs by studying them under a suitable pharmacognostic scheme.

Course Outcome: At the end of the semester the student shall be aware of different sources of crude drugs, cultivation aspects of medicinal and aromatic plants, evaluation methods for crude drugs, the medicinal importance and the role of crude drugs as excipients in various pharmaceutical dosage forms.

UNIT - I

(a) Definition, History and Scope of Pharmacognosy.
(b) Classification of crude drugs: Alphabetical, Morphological, Taxonomical, Chemical constituent and Pharmacological classification of crude drugs.
(c) Scheme for Pharmcognostic study of crude drugs.

UNIT II

a) Cultivation of Crude drugs: Merits and demerits of cultivation of crude drugs. Exogenous factors affecting cultivation. Endogenous factors affecting cultivation: Plant growth regulators.
b) Collection and processing of crude drugs. Methods of collection, drying, garbling and storage of crud drugs.

UNIT - III

a) Quality Control of Crude Drugs: Crude drug Adulteration , Types of adulterants.
b) Evaluation of crude drugs: Organoleptic evaluation, Microscopical, Physical, chemical and Pharmacological evaluation of crude drugs.

UNIT - IV

a) A general introduction to Carbohydrates and Enzymes
b) Systematic Pharmacognostic study of Agar and Isapgol
c) Biological source, collection, preparation, chemical constituents, chemical tests and uses of the following crude drugs – Guar gum, Gum acacia, Honey, Pectin, Starch, Tragacanth, Papain and Diastase.

UNIT - V

a) General Introduction to Lipids
b) Biological source, collection, preparation, chemical constituents, chemical tests and uses of the following crude drugs – Castor oil, Olive oil, Linseed oil, Cod liver oil, Shark liver oil, Cocoa butter, Bees wax, Wool fat.

TEXT BOOKS:

1. Kokate C.K, Purohit AP & Gokhale Pharmacognosy S.B (Nirali)
2. Trease and Evans Pharmacognosy, Latest Edition.
3. A Textbook of Pharmacognosy by Dr. G.S. Kumar and Dr. K.N. Jayaveera

REFERENCES:

1. Atal C.R & Kapur B.M, Cultivation & Utilization of Medicinal Plants.
2. Ayurvedic Pharmacopoeia of India, Pub by Govt. of India.

PS305: PHARMACEUTICAL ANALYSIS –I

B. Pharm II Year I Sem **L T P C 4 1 0 4**

Course Objectives: The basic concepts and analytical techniques of various pharmaceuticals are discussed in a detailed manner.

Course Outcome: The knowledge gained upon the detailed study of the analytical techniques will be useful to analyze the pharmaceutical substances in a systematic qualitative and quantitative manner.

UNIT - I

a) 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.
b) **Theory of Neutralization Titrations**: Acid-base concept, Acidimetry, Alkalimetry, Common ion effect and solubility product, pH, buffers and indicators.
c) 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 2010

UNIT - II

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.
c) **Gravimetry:** Principles, Theory, Precipitation**, co**-precipitation and applications

UNIT - III

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.
c) Polarography: Basic concepts, apparatus and principles, general polarographic analysis, applications in Pharmaceutical Analysis.
d) Amperometric Titrations

UNIT - IV

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 quantitative detection.

UNIT - V

a) Flamephotometry: Introduction, study and working principles of instrumentations used for analysis, applications in pharmaceutical analysis.
b) Principle, instrumentation and applications involved in the follwing
i. Refractometry ii. Polarimetry iii. Nephlometry and turbidimetry
c) Physical and chemical methods of determination of moisture content (including Karl-Fisher method).

TEXT BOOKS:

1. Skoog-Instumental Analysis and Skoog fundamentals of analytical Chemistry
2. A.H. Beckett & J.B Stanlake Vol.I&II., Practical Pharmaceutical Chemistry, Athlone Press of the Univ of London
3. Chatwal & Anand, Instrumental Methods of Analysis.

REFERENCES:

1. A.I Vogel, Quantitative Chemical Analysis, ELBS ed.
2. B.K. Sarma, Instrumental Chemical Analysis, Goel Publishers

PS306: PHARMACEUTICAL ORGANIC CHEMISTRY-II LAB

B. Pharm II Year I Sem **L T P C 0 0 3 2**

I. Synthesis of some simple heterocyclic compounds.

a. 3, 5-Dimethylpyrazole from Acetylacetone.
b. 3, 5-Dimethylisoxazole from Acetylacetone.
c. 4, 5-Diphenylimidazole from Benzil.
d. Benzoxazole from o-Aminophenol.
e. 2, 5-Dioxopiperazine from Glycine.
f. Oxazolone from Benzoylglycine.

II. Molecular rearrangements and named reactions

a. Benzimidazole from o-phenylenediamine (Phillip's Reaction).
b. O-hydroxyacetophenone from phenyl acetate (Fries migration)
c. Benzanilide from benzophenone oxime (Beckmann's rearrangement)
d. Preparation of 2-phenylindole from Phenylhydrazine by Fischer's method.

III. Systematic analysis of organic binary mixtures (Minimum 4 numbers)

REFERENCES:

1. Indian Pharmacopoeia– 2010.
2. A.I. Vogel's – Practical Organic Chemistry
3. Mann and Sounders, Pratical organic chemistry

PS307: PHARMACOGNOSY – I LAB

B. Pharm II Year I Sem

L	T	P	C
0	0	3	2

1. Introduction to the materials required for microscopic work, preparation of histological slides and their focusing to obtain the critical illumination with the instructions for the use of microscope.
2. Preparation of commonly used reagents in microscopic work.
3. Identification of following cell contents in plant materials by microscopical and microchemical tests: Starch grains in potato, maize, rice and wheat.
4. Identification of following cell contents in plant materials by microscopical and microchemical tests
5. Mucilage
6. Aleurone grains
7. Fixed oils
8. Measurement of dimensions of cells and cell contents. Introduction to micrometer and camera lucida (drawing occular).Measurement of dimensions of starch grains in powdered ginger.
9. Identification of cinnamon by measuring the dimensions of starch grains
10. Detection/ identification of Carbohydrates by chemical tests.
11. Detection/ identification of lipids by chemical tests.
12. Isolation of starch from Potato.
13. Determination of Swelling factor in crude drugs
14. Identification of crude drugs mentioned in the theory by Organoleptic method.
15. Identification test for Tannins.
16. Identification test for Resins.
17. Determination of volatile oils content of Eucalyptus leaf or Fennel by using Clevenger apparatus
18. Determination of Eugenol content in clove oil and detection by TLC.

REFERENCES:

1. Kandhelwal, Practical Pharmocognosy.
2. C.K. Kokate et.al, Practical Pharmocognosy.
3. Iyengar, Practial Pharmocognosy
4. Practical Pharmaognosy, Dr. V. Duraiswamy, Dr. K.N. Jayaveera.
5. Anatomy of Crude Drugs by M.A.Iyengar and S.C.K.Nayak – 12th Edition
6. Practical Pharmacognosy by Dr. G.S. Kumar and Dr. K.N. Jayaveera
7. Practical Pharmacognosy by Saroja Joshi and Vidhu Aeri

PS308: PHARMACEUTICAL ANALYSIS – I LAB

B. Pharm II Year I Sem

L	T	P	C
0	0	3	2

1. Assay of Pharmaceutical compounds based on chemical methods such as acid base, oxidation-reduction, non-aqueous, complexometric titration method.
2. Conductometric determination of equivalent point of titration of HCI with NaoH.
3. Potentiometric determination of pH of a solution.
4. Potentiometric titration of strong Acid vs strong Base
5. Potentiometric determination of strength of unknown solution and HCL with NaoH.
6. Nephelometric determination of sulphate & chloride.
7. Fluorimetric estimation of quinine sulphate.
8. Polarographic determination of amount of Nitrobenzene in solutions.
9. Flame photometric determination of Sodium and Calcium.
10. Flame photometric determination of Potassium.
11. Determination of refractive index of liquids by Abbe refractometer.
12. Identification of amino acids by paper chromatography(Ascending and Radial)
13. Identification of alkaloids by TLC.

MC309ES: ENVIRONMENTAL STUDIES

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	0

Course Objectives:

1. Understanding the importance of ecological balance for sustainable development.
2. Understanding the impacts of developmental activities and mitigation measures.
3. Understanding the environmental policies and regulations

Course Outcomes:

1. Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

UNIT - I

Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT - II

Natural Resources: Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

UNIT - III

Biodiversity And Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT - IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics

of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.
Overview of air pollution control technologies, Concepts of bioremediation. **Global Environmental Problems and Global Efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.

UNIT-V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS:

1 Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2 Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela . 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.