

# **Rajiv Gandhi Proudyogiki Vishwavidalaya, Bhopal (M.P.)**

## **B. PHARMA-II SEMESTER**

### **ADVANCED MATHEMATICS PY-201**

- 1. Differential equations and its Applications:** Revision of integral calculus, definition and formation of differential equations, equations of first order and first degree, variable separable, homogeneous and linear differential equations and equations reducible to such types, linear differential equations of order greater than one with constant coefficients, complementary function and particular Integral, Simultaneous linear differential equations, pharmaceutical applications.
- 2. Laplace Transforms:** Definition, transforms of elementary functions, properties of linearity and shifting, inverse Laplace transforms, transforms of derivatives, solution of ordinary and simultaneous differential equations.
- 3. Biometrics:** Significant digits and rounding of numbers, data collection, random and non-random sampling methods, sample size, data organization, diagrammatic representation of data, bar, pie, 2-D and 3-D diagrams, measures of central tendency, measures of dispersion, standard deviation, standard error of means, coefficient of variations, confidence (fiducial) limits.
- 4. Probability:** probability and events, Bayes theorem, probability theorems, probability distributions, elements of binomial and poisson distribution, normal distribution curve and properties,
- 5. Correlation and regression:** Method of least squares, statistical inference, Student's and paired t-test, F-test and elements of ANOVA, kurtosis and skewness, Applications of statistical concepts in Pharmaceutical Sciences.

**BOOKS RECOMMENDED:**

1. Paria G., Ordinary Differential Equations with Laplace transform, Scholar's Publications, Indore.
2. Paria G., Differential Calculus, Scholar's Publications, Indore.
3. Paria G., Integral Calculus, Scholar's Publications, Indore.
4. Paria G., Statistics and Stochastic Process Part I and II, Scholar's Publications, Indore.
5. Baisnab A, and M Jas, Introduction to statistics.

## PHARMACEUTICS-II PY-202 (PHYSICAL PHARMACY)

- 1. Micromeritics and Powder Rheology:** Introduction, Particle size and size distribution: Average particle size, particle size distribution, number and weight distribution, particle number; Methods for determination particle size: optical microscopy, sieving, sedimentation; introduction to latest technique in particle analysis Particle volume measurement; Particle shape and surface area: particle shape, specific surface; Methods for determining surface area: adsorption method, air permeability method, pore size; Derived properties of powders: Porosity, packing arrangement, densities of powder, bulkiness and flow properties, Compaction: Compressed tablet, Pharmaceutical application.
- 2. Solubility and Distribution Phenomenon:** General principles: the phase rule, solubility expressions; Solvent-solute interaction: polar solvents, nonpolar solvents, semipolar solvents; Solubility of gases in liquids: Effect of pressure, temperature, salting out, effect of chemical reaction; Solubility of liquids in liquids: Ideal and real solution, complete miscibility, partial miscibility, influence of foreign substance, three component systems, dielectric constant and solubility, molecular connectivity, molecular surface area and solubility; Solubility of solids in liquids: Ideal solutions, Phase diagrams and the ideal solubility equation, nonideal solution, extended Hildebrand solubility approach, solvation and association in solutions of polar compounds, solubility and the heat of solution, solubility of strong electrolytes, solubility of slightly soluble electrolytes, solubility of weak electrolyte, the influence of solvents on the solubility of drugs, combined effect of pH and solvents, influence of surfactants; **influence of hydrotropic agents on solubility of drugs.** Distribution of solutes between immiscible solvents.
- 3. Surface and Interfacial Phenomenon:** Liquid interfaces: surface and interfacial tensions, surface free energy. Measurement of surface and interfacial tensions: Capillary rise method, The DuNouy Ring Method. Adsorption at liquid interfaces: surface active agents, Systems of Hydrophile - Lipophile classification, Type of

mono-layers at liquid interfaces. Adsorption at solid interface, the solid-gas interface, the solid-liquid interface, Activated Charcoal, Wetting, Application of surface-active agents, Electric properties of interfaces.

- 4. Diffusion and Dissolution:** Concept of diffusion, Study state diffusion: Fick's first law, Fick's second law, study state, Procedure and apparatus. Dissolution: dissolution rate, dissolution of tablets, capsules and granules, Powder Dissolution: The Hixson-Crowell cube Root Law. Drug release: Drugs in polymer matrices, release from granular matrices, multilayer diffusion, membrane control and diffusion layer control phenomenon, diffusion principle in biological system.
- 5. Viscosity and Rheology:** Newtonian Systems: Newton's Law of flow; kinematics viscosity; Temperature dependence and theory of viscosity. Non-Newtonian Systems: plastic flow, pseudoplastic and dilatant flow. Thixotropy: measurement thixotropy, Bulges and spurs, Negative thixotropy, Thixotropy in formulations. Determination of Rheologic properties: choice of viscometer, Capillary viscometer, Falling sphere viscometer, Cup and bob viscometer, Cone and plate Viscometer, Pharmaceutical application of Rheology.
- 6. Complexation and protein binding:** Classification of complexes, methods of preparation and analysis, Pharmaceutical applications. Protein binding: Binding equilibria, equilibrium dialysis and ultrafiltration, dynamic dialysis, hydrophobic interaction, self-association, factors affecting complexation and protein binding.
- 7. Buffered and isotonic solutions:** The buffer equation: Common Ion Effect and the Buffer Equation for a weak Acid and its salt, The buffer equation for a weak base and its salt. Factors influencing the pH of buffer solutions. Buffer capacity: Calculation of buffer capacity. Buffer in pharmaceutical systems and biologic system: In vivo biologic buffer systems, Pharmaceutical buffers, influence of buffer capacity and pH on Tissue Irritation, pH and Solubility. Buffered isotonic solutions: Measurement of tonicity, tonicity calculations, Methods of adjusting isotonicity and pH.

**8. Colloids:** Introduction to the dispersed System, Types of colloidal systems, Optical properties of the colloids, kinetic properties of the colloids, electrical properties of the colloids, Solubilization, Pharmaceutical application of the colloids, advanced thermodynamics of Micellization.

**9. Coarse Dispersion: Suspension:** Interfacial properties of suspended particles, Settling in suspensions: theory of sedimentation, effect of Brownian Movement, Sedimentation of flocculated particles, Sedimentation parameters. Formulation of suspensions: Wetting of particles, Controlled flocculation, Flocculation in Structured Vehicles, Rheologic consideration, Preparation of suspensions, Physical stability of suspensions. **Emulsions:** Emulsion types, Pharmaceutical applications, Theories of emulsification, Physical stability of emulsions, Preservation of emulsions, Rheologic properties of emulsions. **Semi-solids:** Gels, Syneresis and swelling, Classification of Pharmaceutical semisolids, Hydrophilic properties of Semisolids, Rheologic properties of semisolids, Universe of Topical Medications. Drug Kinetics in Coarse disperse system, Drug Diffusion in Coarse Disperse Systems.

#### **LIST OF PRACTICALS:**

**(Minimum fifteen experiments should be performed in the semester. Student should aware with safety parameters and handling of chemicals related to following experiments)**

1. Determine the particle size and particle size distribution in the given sample of powder by optical microscopy.
2. Determine particle size distribution of the given granules by sieving method.
3. Determine the following derived properties of the given powdered sample
  - (a) Flow property
  - (b) Bulk density
  - (c) Granule density
  - (d) True density
  - (e) Porosity
  - (f) Carr's Index
  - (g) hussnor's retio
4. Determine the surface tension of the given sample by drop count and drop weight Method.

5. Determine the Critical Micelle Concentration (CMC) of the given surfactant by Surface tension method.
6. Determine partition coefficient of the given drug between benzene and water or octanol and water system
7. Plot phase diagram of phenol-water system
8. Determine the effect of salt on the solubility of given drug.
9. Determine the percent composition of an unknown solution of glycerin in water using Ostwald's viscometer
10. Study the effect of shear rate on the flow of 1% methyl cellulose solution.
11. Formulate suspension of the given drug and evaluate it for sedimentation parameters.
12. Study the effect of thickening agent concentration on the sedimentation of the suspension of the given drug.
13. Prepare acetate buffer and compare theoretical pH value with the experimental value.
14. Determine the viscosity of the following Newtonian and Non-Newtonian system
  - (a) Water
  - (b) Simple syrup I.P.
  - (c) Diclofenac gel
  - (d) Tooth paste
15. Determine the HLB value of the given surfactant
16. Evaluate the given sample of emulsion on the following parameters
  - (a) Type of emulsion
  - (b) Globule size distribution
  - (c) Physical stability
  - (d) Viscosity
17. Determine the optimum concentration of Bentonite required for the maximum physical stability of calamine lotion.
18. **To observe the effect of hydrotropic agent sodium citrate on the solubility of salicylic acid.**

#### **BOOKS RECOMMENDED:**

1. Lachman, L., Lieberman, H.A. and Kanig, J.L., The Theory and Practice of Industrial Pharmacy, Lea and Philadelphia.
2. Allen, L.V., Popovich, N.G., Ansel, H.C., Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, Lippincott Williams and Wilkins.

3. Banker G.S. and Rhode C.T., Modern Pharmaceutics, Marcell Decker Inc., New York.
4. Aulton, M.E., Pharmaceutics The Science of Dosage Form Design, Churchill Livingstone, London.
5. Carter, S.J., Cooper and Gunn's Tutorial Pharmacy, CBS Publishers and Distributors, New Delhi.
6. Martin A., Physical Pharmacy, Lippincott Williams and Wilkins.
7. Gennaro, A.R., Remington: The Science and Practice of Pharmacy, Lippincott Williams and Wilkins.

## PHARMACEUTICAL CHEMISTRY-III PY-203 (ORGANIC-I)

- 1. Structure and Properties:** Electronegativity, Polarity, Resonance; Electrophiles/Nucleophiles, Orbitals,  $\pi$ -Bonds, Hybridization and Shape, Isomerism, Polarity, Intermolecular Forces, isotope effects and isotopic labelling.
- 2. Reactive Intermediates:** Stability and reactivity of Radicals, Cations, Anions, Nitrene and Nitrenium ion
- 3. Stereochemistry:** Stereo-isomerism, classification and Nomenclature, Optical activity, Chirality, R/S Classification of Chiral Carbons. Miscellaneous Stereochemistry, Diastereomers; Racemic modification, Resolution of racemic mixtures.
- 4. Hydrocarbons: Alkanes and cycloalkanes:** Nomenclature, Physical and chemical properties of alkanes, Conformations and Stability of Acyclic Alkanes and Cycloalkanes.  
  
**Alkenes and alkynes:** Nomenclature, Physical and Chemical properties of alkenes, isomerism, and general methods of preparation.  
  
**Aromatic hydrocarbons:** Benzene and its homologues (Polynuclear compounds), nomenclature, sources of aromatic hydrocarbons, structure of benzene, chemical reaction of benzyne-mechanism and  $S_NAr$  Mechanism of nucleophilic substitution. Directive influence of substituents and their effect on reactivity.  
  
**Dienes and the Allyl system:** Conjugation, Reactivity.
- 5. Organic compounds with functional groups containing halogens (X):** Nomenclature, Structure, Properties, Reactivity of Alkyl Halides (haloalkanes and haloarenes): The  $S_N2$  and  $S_N1$  Substitution Reaction, The  $E1$  and  $E2$  Elimination



Reactions, Substitution vs. Elimination reaction, reactivity of C-X bond in haloalkanes and haloarenes

**6. Organic compounds with functional groups containing oxygen (Part I):**

**Alcohols:** Nomenclature, Synthesis, reactivity of different Alcohols; conversion of Alcohols to Tosylates or Halides.

**Phenols:** Nomenclature, methods of preparation, physical and chemical properties; chemical reactivity of phenols in electrophilic substitutions, acidic nature of phenol.

**Ethers:** electronic structure, structure of functional group, nomenclature, important methods of preparation, physical and chemical properties, some commercially important compounds.

**7. Organic compounds with functional groups containing oxygen (Part II):**

**Aldehydes and ketones :** Electronic structure of carbonyl group, nomenclature, important methods of preparation, physical properties and chemical reactions, relative reactivity of aldehydic and ketonic groups, aldol condensation. nucleophilic addition reaction to  $>\text{C}=\text{O}$  groups.

**Carboxylic acids:** Electronic structure of  $-\text{COOH}$ , Nomenclature, important methods of preparation, physical properties and effect of substituents on  $\alpha$ -carbon on acid strength, chemical reactions.

**Derivatives of carboxylic acids:** Electronic structure of acid chloride, acid anhydride, ester and amide groups, Nomenclature, important methods of preparation, comparative reactivity of acid derivatives.

**8. Organic Compounds with functional group containing Nitrogen:** Structure, Nomenclature of Amino and Diazo Compounds.

**Amines:** Primary, secondary and tertiary amines, a general awareness, important methods of preparation, physical properties, basic character of amines, chemical reactions.

**Diazonium salts:** Preparation, chemical reaction and uses of Benzene diazonium chloride. Some commercially important nitrogen containing carbon compounds, (Aniline, TNT)

### **LIST OF PRACTICALS:**

1. Purify the given organic compounds by distillation.
2. Purify the given organic compounds by recrystallization.
3. Introduction to the use of stereo models.
4. Synthesis, Purification, Characterization (by using Solubility, Melting Point, T.L.C. and percentage purity) of organic compounds and percent yield calculations of the following compounds:
  - a) 2, 4, 6-trinitro phenol (Picric acid) from phenol
  - b) Iodoform from ethyl alcohol
  - c) 2, 4, 6-tribromoaniline from aniline
  - d) 2, 4, 6-tribromo phenol from phenol
  - e) Phenylbutazone from phenol
  - f) Benzanilide from aniline
  - g) Phthalidimide from phthalic anhydride
  - h) Thiourea
  - i) Phenyl urea
  - j) Flourescein
  - k) Methly orange
  - l) Methly red

**BOOKS RECOMMENDED:**

1. Organic Chemistry, R.T. Morrison and R.N. Boyd, 6<sup>th</sup> Edition, New York.
2. Organic Chemistry, T.W.G. Solomons, 8<sup>th</sup> Edition, John Wiley & Sons, Inc
3. Advanced Organic Chemistry, J. March, Reaction Mechanisms and Structure, John Wiley and Sons, N.Y.
4. Mechanisms and structure in Organic Chemistry, E.S. Gould, Hold Rinchart and Winston, New York.
5. Advanced Organic Chemistry, Reaction Mechanisms, Bernard Miller, 2nd edition, Pearson education Ptc. Ltd. Singapore.
6. Named Organic Reactions, Thomas Lane & Andreas Plagens, 2nd edition, John Wiley and Sons, N.Y).
7. Organic Chemistry Finar Vol-1 & 2.
8. Structure and Mechanism in Organic Chemistry, Ingold, C. K., Cornell University.
9. Stereochemistry of Carbon Compounds, Eliel, E.L., McGraw Hill, New York.
10. Elements of Stereochemistry, Eliel, E.L., Wiley, New York.

## PHARMACOGNOSY-I PY-204

1. Study of following families with spatial reference to medicinally important plants; apocyanaceae, solanoceae, gramineae, labiatae, cruciferae, papaveraceae, umbelifereae, leguminosae, rubiaceae and liliaceae.
2. Definition, history, scope and development of Pharmacognosy. Scheme for pharmacognostical study of crude drug. Sources of crude drugs and methods of their classification. Traditional and alternative systems of medicines.
3. Cultivation collection, drying, natural drying, artificial drying, processing and storage of crude drugs. Factors affecting cultivation of medicinal plants like climate, altitude, temperature, humidity, rainfall, soils, fertilizers and manures.
4. Pest control and natural pest control agents. Methods of pest control like mechanical, agricultural, biological chemical etc.
5. Quality Control of Crude Drugs: Different types of Adulteration and their evaluation using various methods like Organoleptic, Microscopic, Physical, Chemical, and Biological, Quantitative microscopy.
6. General methods of their isolation, classification, properties and systematic pharmacognostic study of –
  - a. Carbohydrates, and drugs belonging to this class like; Agar, Gaur gum, Acacia, Ghatti gum Honey, Isapgol, Starch, Sterculia, Tragacanth, Bael, Pectin,
  - b. Fixed oil, fats and waxes and drugs belonging to this class likes; Castor oil, Olive oil Linseed oil, Karanj Oil, Neem Oil, Beeswax, Cocoa butter, Hydnocarpus oil, Kokum butter, Cod-liver oil, Shark liver oil, Woolfat, Lard, Yellow bees wax, Carnauba wax
  - c. Resins and resin combinations and drugs belonging to this class like; Podophyllum, Tolu & Peru balsam, Turmeric, Ginger, Ipomoea, Myroballan,

Asafoetida, Benzoin, colophonoy. Capsicum, Canabis, Myrrh, Guggul, Kaladana,

- d. Tannins and drugs belonging to this class like Myrobalan, Bahera, Arjuna bark, Ashoka bark, Amla, black & Pale catechu.
- e. Fibres: Plant fibres, Animal fibre, Synthetic fibres, Mineral fibre. Flax, Cotton, Silk, Wool.
- f. Pharmaceutical aids like; Talc, Kaolin, Bentonite, Gelatin, Kieselguhr, Asbestose.

### **LIST OF PRACTICALS:**

**(Student should perform Minimum fifteen experiments from following)**

1. Study of different types of microscopes, camera lucida.
2. Morphological identification of following drugs Bael, Capsicum, Kaladana, catechu, guggul, honey.
3. Morphological identification of following drugs Arjuna bark, ashoka bark. Amla. Ghatugum and Bahera
4. Perform the morphological, microscopic and chemical evaluation "Ginger".
5. Perform morphological, microscopic and chemical evaluation of "Turmeric".
6. Perform morphological and chemical evaluation of "Myroballan".
7. Perform morphological and chemical evaluation of "Agar and Acacia".
8. Perform morphological and chemical evaluation of "Tragacanth".
9. Perform morphological, microscopic and chemical evaluation of "Isapgol".
10. Perform morphological, microscopic and chemical evaluation of "Starches obtain from potato, rice, maize and wheat".
11. Perform morphological and chemical evaluation of "Asafoetida".
12. Perform morphological and chemical evaluation of "Castor oil, linseed oil, olive oil, cod-liver oil".
13. Perform morphological and chemical evaluation of neem oil, cocoa butter and wool fat.
14. Perform morphological and chemical evaluation of lard, bees wax and carnauba.
15. Perform morphological and chemical evaluation of "Bees wax".
16. Perform morphological and chemical evaluation of "Benzoin".

17. Perform morphological, microscopic and chemical evaluation of “nylon, Silk and Cotton”.
18. Perform morphological, microscopic and chemical evaluation of “Talc and Podophyllum”.
19. Perform morphological, microscopic and chemical evaluation of “Peru and Tolu Balsam”.
20. Identify the given mixture/sample of powder drugs by morphological microscopical and chemical evaluation.

**BOOKS RECOMMENDED:**

1. Text Book of Pharmacognosy – C.S.Shah & J.S.Quadry
2. Text Book of Pharmacognosy – T.E. Wallis
3. Pharmacognosy – Trease & Evans
4. Pharmacognosy – Brady & Taylor
5. Text Book of Pharmacognosy – V.K. Kapoor & S.S.Handa
6. Pharmacognosy – C.K.Kokate, A.P.Purohit, S.B.Gokhale.

## **ANATOMY PHYSIOLOGY AND HEALTH EDUCATION–PY-205**

Scope of anatomy and physiology and basic terminology used in these subjects.

1. Structure of cell, its components and their function:
2. **Elementary Tissues of the Human Body:** Epithelial, connective, muscular and nervous tissues; their sub-types and characteristics.
3. **Skeletal System:** Structure, composition and functions of skeleton, Classification of joints, Types of movement at joint, disorders of joints.
4. **Skeletal Muscles:** Their gross anatomy, physiology of muscle contraction, physiological properties of skeletal muscle and their disorders.
5. **Haemopoietic System :** Composition and functions of blood and its elements, their disorders, blood groups and their significance, mechanism of coagulation; disorders of platelets and coagulation.
6. **Lymph and lymphatic system:** Composition, formation and circulation of lymph, disorders of lymph and lymphatic system. Basic physiology and functions of spleen.
7. **Cardiovascular System:** Basic anatomy of the heart, physiology of heart, blood vessels and circulation. Basic understanding of cardiac cycle, heart sounds and electrocardiogram. Blood pressure and its regulation. Brief outline of cardiovascular disorders like; hypertension, hypotension, arteriosclerosis, angina, myocardial infraction, congestive heart failure and cardiac arrhythmias.
8. **Respiratory System:** Anatomy of respiratory organs, Functions of respiration, Mechanism and regulation of respiration, Respiratory volumes and vital capacity
9. **Health Education:** First aid: emergency treatment of shock, snake bites, burns, poisoning, fractures and resuscitation methods.

## **LIST OF PRACTICALS:**

**(Student should perform all the following experiments)**

1. Determine RBC count of the given blood sample
2. Determine WBC count of the given blood sample
3. Determine differential WBC count of the given blood sample
4. Determine platelets count of the given blood sample
5. Determine hemoglobin count of the given blood sample
6. Determine clotting time of the given blood sample.
7. Determine erythrocyte sedimentation rate of the given blood sample
8. Osmotic fragility of the blood.
9. Determine blood group.
10. Study of epithelial, connective, muscular and nervous tissue using slide.
11. Study human skeletal system with the help of chart, model and histological slides.
12. STUDY of human cardiovascular system with the help of chart, model and histological slides.
13. Record of blood pressure.
14. To understand ECG, PQRST waves and their significance.
15. Study of human respiratory system with the help of chart, model and histological slides.
16. Study of lymphatic system with the help of chart, model and histological slides.