

B.Pharm Syllabus

Semester 02

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BP201T - Applied Biostatistics and Data Analytics for Pharmaceutical Sciences

Theory

Unit I

- Descriptive Statistics
- Types of data in pharmaceutical sciences (nominal, ordinal, interval, ratio)
- Sources of data in pharmacy: clinical trials, pharmacovigilance, quality control, PK studies
- Measures of central tendency: mean, median, mode, their calculation and interpretation
- Measures of dispersion (range, variance, standard deviation) and their interpretation using pharmaceutical data
- Skewness and understanding distribution shape in biological measurements
- Perform descriptive statistical analysis using Python libraries such as NumPy and Pandas, with focus on Interpretation of results.

Unit II

- Probability & Statistical Distributions in Healthcare
- Basic probability concepts and laws (addition and multiplication rules), conditional probability and its interpretation
- Bayes' theorem and its application in clinical decision-making
- Concept of random variables (discrete and continuous)
- Normal distribution and its importance in biological and pharmaceutical measurements,
- Binomial distribution demonstrating applications in clinical trial outcomes
- Poisson distribution for modeling rare events such as adverse drug reactions
- Graphical visualization of these probability distributions using Python.

Unit III

- Sampling & Statistical Inference
- Population versus sample, sampling techniques used in clinical research, Sampling error and bias
- Conceptual understanding of the Central Limit Theorem
- Confidence intervals and their interpretation
- Hypothesis testing framework (null and alternative hypotheses)
- Type I and Type II errors, p-value and statistical significance
- Demonstration, calculation and interpretation of these parameters using python with pharmaceutical data.

Unit IV

- Basics of Correlation & Regression Conceptual understanding of the following concepts with emphasis on their interpretation-correlation and Pearson correlation coefficients
- Interpretation of positive and negative correlations
- Scatter plots and trend visualization using pharmaceutical data such as dose-response relationships
- Simple linear regression concept, interpretation of regression coefficients
- Introduction to odds ratio and its application in clinical risk analysis.

Unit V

- Statistical Analysis Using Python - Case based learning
- Demonstration of descriptive statistics, correlation analysis and linear regression using Python libraries-SciPy / Statsmodels / Scikit-learn on pharmaceutical datasets
- Interpretation of the output summaries and p-values
- Preparation of statistical reports

BP202T / BP207P - Biochemistry

Theory

Unit I

- Enzymology
- Introduction, properties, nomenclature, and IUB classification of enzymes and coenzymes. Enzyme kinetics (Michaelis plot, Lineweaver-Burk plot). Enzyme inhibitors with examples. Regulation of enzymes: enzyme induction and repression, allosteric enzyme regulation.
- Therapeutic and diagnostic application of enzymes and isoenzymes.
- Factors affecting enzyme activity. Digestion, absorption function of dietary Macro and Micronutrients, including Vitamins and Minerals, Biochemical functions of vitamins and associated diseases.
- Clinical Chemistry: Liver function tests (routinely performed tests based on liver function). Renal function tests (routinely performed tests based on kidney function, ELISA test)

Unit II

- Introduction about biomolecules - Introduction of carbohydrate, lipids, nucleic acids, amino acids and proteins.
- Bioenergetics: Concept of free energy; relationship between free energy, enthalpy, and entropy; redox potential; energy-rich compounds (ATP, GTP, etc.) and their biological significance.
- Carbohydrate Metabolism and their role in diabetes mellitus: Overview and significance of major pathways: Glycolysis, Citric Acid Cycle (TCA), Gluconeogenesis, Hexose Monophosphate (HMP) shunt, and Glycogen metabolism; regulation of blood glucose levels; metabolic adaptations during fed state, fasting, and prolonged starvation; metabolic derangements in diabetes mellitus and related disorders.
- Biological Oxidation: Electron Transport Chain (ETC), oxidative phosphorylation, and mechanisms of ATP synthesis; regulation and clinical implications of mitochondrial dysfunction and oxidative stress.

Unit III

- Lipid metabolism
- Classification, functions, and properties of lipids and lipoproteins (HDL, LDL, VLDL, chylomicrons)
- β -oxidation and de-novo synthesis of fatty acids: Ketone bodies: synthesis, utilization, and clinical significance
- Biological significance of cholesterol, lipid profile, and its clinical significance
- Disorders associated with lipid metabolism: Hyperlipidaemias and hypercholesterolemia, lipid storage diseases, atherosclerosis, fatty liver disease, and obesity.

Unit IV

- Amino acids and protein metabolism
- Classification and Biological Functions: Classification and physiological roles of amino acids. Structure and functions of proteins and plasma proteins

- General Metabolism of Amino Acids: Transamination, oxidative and non-oxidative deamination, decarboxylation. Urea cycle - nitrogen disposal and detoxification. Fate of carbon skeletons of amino acids (glucogenic vs ketogenic).
- Catabolism of Specific Amino Acids and Related Disorders: Catabolism of phenylalanine and tyrosine and their metabolic disorders
- (Phenylketonuria, Albinism, Alkaptonuria, Tyrosinemia) and Inborn errors of branched chain and aromatic amino acids
- Biochemical significance of neurotransmitters and hormones derived from amino acids: 5-HT (serotonin), melatonin, dopamine, noradrenaline, adrenaline
- Catabolism of heme and related disorders (jaundice).

Unit V

- Nucleic acid metabolism and genetic information transfer
- Nucleotide Metabolism and their related disorders: Biosynthesis of purine and pyrimidine nucleotides. Catabolism of purine nucleotides (uric acid formation). Clinical significance of Hyperuricemia and Gout.
- Genome Structure and Central Dogma: Organization of the mammalian genome. Introduction to DNA replication, Transcription, and Translation.
- Genetic Code and Regulation of Protein Synthesis: Properties of the genetic code: Inhibitors of transcription and translation (antibiotics, toxins)
- DNA Repair and Related Disorders: DNA damage types, Repair mechanisms. Overview of clinical disorders associated with faulty DNA repair.

Practical

- Identification tests for proteins (Albumin and Casein).
- Qualitative analysis of carbohydrates* (Glucose, Fructose, Lactose, Sucrose, and Starch).
- Qualitative analysis of urine for normal and abnormal constituents.
- Estimation of blood glucose.
- Estimation of total cholesterol and HDL cholesterol.
- Estimation of urea, creatinine, and uric acid in serum.
- Estimation of serum total protein and albumin.
- Study of enzymatic hydrolysis of starch.
- Study of the effect of temperature on salivary amylase activity.
- Study of the effect of substrate concentration on salivary amylase activity.
- Estimation of hemoglobin in blood by Sahli's method / Cyanmethemoglobin method.
- Estimation of serum bilirubin (total and direct bilirubin).
- Estimation of glycogen content
- Estimation of SGOT and SGPT

BP203T / BP208P - Human Anatomy, Physiology and Pathophysiology II

Theory

Unit I

- Nervous System
- Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse and neurotransmitters.
- Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid. Structure and functions of brain (cerebrum, brain stem and cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity).
- Pathophysiology of epilepsy, Parkinson's disease, stroke, migraine, depression, schizophrenia, Alzheimer's disease and meningitis.

Unit II

- Gastrointestinal System
- Anatomy of GI tract with special reference to anatomy and functions of stomach (acid production in the stomach and its regulation through parasympathetic nervous system; role of pepsin in protein digestion).
- Anatomy and functions of small intestine and large intestine. Anatomy and functions of salivary glands, pancreas and liver. Movements of GIT, digestion and absorption of nutrients.
- Pathophysiology of inflammatory bowel diseases, peptic ulcer, jaundice, hepatitis, typhoid and alcoholic and non alcoholic fatty liver disease

Unit III

- Respiratory System Anatomy of respiratory system with special reference to anatomy of lungs.
- Mechanism of respiration and regulation of respiration. Lung volumes and capacities, transport of respiratory gases, artificial respiration and resuscitation methods.
- Pathophysiology of asthma, chronic obstructive pulmonary diseases and tuberculosis.
- Urinary System Anatomy of urinary tract with special reference to anatomy of kidney and nephrons. Functions of kidney and urinary tract. Physiology of urine formation, micturition reflex and role of kidneys in acid-base balance.
- Role of Renin Angiotensin Aldosterone System in kidney.
- Pathophysiology of acute and chronic renal failure and urinary tract infections.

Unit IV

- Endocrine System
- Classification of hormones and mechanism of hormone action. Structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland and thymus.
- Pathophysiology of diabetes, hypothyroidism, hyperthyroidism, goitre and polycystic ovary syndrome.

Unit V

- Reproductive System and Cancer
- Anatomy of male and female reproductive system. Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition.
- Pathophysiology of sexually transmitted diseases: AIDS, syphilis and gonorrhea.
- Etiology and pathogenesis of cancer.

Practical

- Study of nervous system using specimens and models.
- Study of respiratory system using models.
- Study of gastrointestinal system using models.
- Study of reproductive system using models.
- Demonstration of general neurological examination.
- Demonstration of function of olfactory nerve.
- Examination of different types of taste.
- Demonstration of visual acuity.
- Demonstration of reflex activity.
- Recording of body temperature.
- Determination of tidal volume and vital capacity.
- Recording of body mass index (BMI).
- Study of family planning devices and pregnancy diagnosis tests.
- Understanding pathophysiology of IBD, peptic ulcer, jaundice, hepatitis, typhoid, asthma, tuberculosis, diabetes, and thyroid disorders through case files / case reports.
- Hands-on training in cardiopulmonary resuscitation (CPR).

BP204T / BP209P - Pharmaceutical Organic Chemistry

Theory

Unit I

- Aliphatic Saturated Hydrocarbons - Alkanes
- Methods of preparation: Wurtz reaction, Kolbe's reaction, Clemmensen reduction, Wolff-Kishner reduction
- Chemical reactions of alkanes
- Mechanism of free radical substitution (halogenation)
- Pharmaceutical applications of alkanes: Liquid paraffin, soft paraffin, hard paraffin Cycloalkanes
- Baeyer's strain theory and its limitations
- Coulson-Moffitt modification
- Sachse-Mohr theory.

Unit II

- Aliphatic Unsaturated Hydrocarbons - Alkenes
- Methods of preparation: o Dehydration of alcohols o Dehydrohalogenation of alkyl halides o Dehalogenation of vicinal dihalides o Wittig reaction
- Chemical reactions of alkenes
- Mechanism of electrophilic addition reactions
- Markovnikov's and anti-Markovnikov's rule
- Ozonolysis Conjugated Dienes
- Stability of conjugated dienes
- Mechanism of Diels-Alder reaction Electrophilic and free radical addition reactions
- 1,2-and 1,4-addition reactions.

Unit III

- Alkyl Halides
- Nucleophilic substitution reactions: SN1 and SN2 o Mechanism, kinetics, substrate structure, solvent effect, stereochemistry
- Elimination reactions: E1 and E2 o Mechanism, kinetics, substrate structure, solvent effect, stereochemistry
- Zaitsev's (Saytzeff's) rule with examples
- Comparison of substitution vs elimination reactions

Unit IV

- Benzene and Its Derivatives - -
- IUPAC nomenclature of mono-and di-substituted benzene derivatives

- Structure of benzene
- Molecular orbital picture and resonance
- Aromaticity and Hückel's rule
- Electrophilic aromatic substitution reactions: o Nitration o Halogenation o Friedel-Crafts alkylation and its limitations o Friedel-Crafts acylation o Sulphonation and desulphonation
- Effect of substituents on reactivity and orientation.

Unit V

- Carbonyl Compounds - Aldehydes and Ketones
- Preparation and properties of carbonyl compounds
- Nucleophilic addition reactions
- Aldol condensation and crossed aldol condensation
- Cannizzaro and crossed Cannizzaro reactions
- Benzoin and Perkin condensation
- Oxidation and reduction reactions
- Pharmaceutical applications of carbonyl compounds: Chloral, Paraldehyde, Ketoprofen

Practical

- Systematic qualitative analysis of water-insoluble or water-immiscible unknown organic compounds from different chemical classes:
- Preliminary tests: Color, odour, Solubility tests, test for aromaticity, test for saturation/unsaturation etc.
- Detection of elements such as nitrogen, sulphur and halogens by Lassaigne's test
- Determination of Functional group tests such as phenols, amides, amines, carboxylic acids, aldehydes and ketones, alcohols, esters, aromatic and halogenated hydrocarbons and nitro compounds.
- Preparation of the derivatives and confirmation of the unknown organic compound by melting point / boiling point.
- Building Molecular Models: Students will use ball-and-stick models to create structures of molecules and understand their shapes and bonding.
- Crystallization Method Students will learn how to purify three organic compounds using the crystallization technique.

BP205T / BP210P - Pharmacognosy and Phytochemistry

Theory

Unit I

- Metabolic pathways and biogenetic studies: Basic metabolic pathways and biosynthesis of secondary metabolites, including shikimic acid, acetate and amino acid pathways.
- Utilisation of radioactive isotopes in biogenetic studies.
- Introduction to pathway prediction tools and modern genetic tools such as CRISPR/Cas9.

Unit II

- Primary metabolites: General classification and identification tests; pharmacognostic study covering biological source, distribution, identifying characters, chemical constituents, specific tests, therapeutic uses and commercial applications.
- Carbohydrates: Acacia, agar, tragacanth and honey.
- Proteins and enzymes: Gelatin and casein; proteolytic enzymes including papain, bromelain, serratiopeptidase, urokinase, streptokinase and pepsin.
- Lipids (waxes, fats and fixed oils): Castor oil, olive oil, cocoa butter, wool fat and beeswax.

Unit III

- Secondary metabolites: General classification and identification tests; pharmacognostic study covering biological source, distribution, cultivation of selected drugs, identifying characters, chemical constituents, specific tests, therapeutic uses and commercial applications.
- Alkaloids: Vinca, Rauwolfia and opium.
- Volatile oils: Lemongrass, clove, cinnamon and fennel.
- Tannins: Myrobalans, catechu and pomegranate.
- Resins: Guggul and asafoetida.
- Glycosides: Senna, liquorice and digitalis.
- Phenylpropanoids and flavonoids: Green tea, ginkgo and flax seed.
- Iridoids, other terpenoids and naphthoquinones: Gentian and Artemisia.

Unit IV

- Extraction methods for medicinal plants.
- Conventional methods: Infusion, decoction, digestion, maceration, percolation, reflux, distillation, Soxhlet extraction and successive solvent extraction.
- Modern methods: Supercritical fluid, microwave-assisted, ultrasonic-assisted, enzyme-assisted and pressurised liquid extraction.

Unit V

- Overview of isolation, identification and characterisation techniques.

- Separation and isolation: Planar chromatography, column chromatography, preparative TLC and flash chromatography.
- Identification: Phytochemical tests, chromatographic techniques and spectroscopic techniques.
- Fingerprinting of medicinal plants using TLC/HPTLC.
- Types and significance of markers (phytochemical reference standards).
- Screening and analysis of major metabolites: Alkaloids, glycosides, saponins, tannins, resins, flavonoids, phenolics and steroids.

Practical

- Chemical tests for identification of Agar, Acacia, Tragacanth, Honey.
- Chemical tests for identification of Castor oil, Olive oil, Wool fat, Beeswax.
- Chemical tests for identification of Asafoetida, Catechu, Aloe.
- Transverse section and powder microscopy of a vinca leaf.
- Transverse section and powder microscopy of a cinnamon bark.
- Transverse section and powder microscopy of a fennel fruit.
- Transverse section and powder microscopy of a clove flower bud.
- Transverse section and powder microscopy of a Tulsi stem.
- Transverse section and powder microscopy of a Liquorice roots.
- Study of effect on different extraction techniques on yield of crude extract (maceration, decoction, soxhlation).
- Isolation of volatile oil and it's TLC.
- Isolation of caffeine from tea.
- Isolation of Hesperidin from lemon peel.
- Isolation of Glycyrhizin from liquorice roots.
- Isolation of Pectin from orange peel.
- Experiential learning based experiment involving evaluation and comparison of field/market collected herbal raw materials with Pharmacopoeial standards.

BP206T / BP211P - Physical Pharmaceutics

Theory

Unit I

- Solubility distribution phenomenon & buffers Solubility expression, Solute solvent interactions, Solubility of liquid and liquids, Solubility of solids and liquids, Solubility of Gas in Liquids, Raoult's Law. Factors affecting solubility, Measurement of saturation Solubility, Effect of pH on solubility, Partition Coefficient - Measurement and significance, Critical Solution Temperature and Applications.
- Introduction to buffers, Buffers in pharmaceutical and biological system, pH determination methods (Electrometry and colorimetry). Buffer equation / Factor influencing the pH of buffer solutions, Factor influencing Buffer capacity, General procedure for preparing buffers, Indicators.

Unit II

- Interfacial phenomenon Liquid interface: Surface and interfacial tension, surface free energy, Measurement of surface and interfacial tension, Spreading coefficient, surface active agent, HLB, detergency, types of monolayers at liquid surface. Adsorption at solid interface, Liquid Interface (contact angle, activated charcoal and Wetting). Adsorption of surface-active agents.
- Electric properties of interface / Electric double layer, Nernst and zeta potential effect of electrolytes.

Unit III

- Colloidal and Coarse Dispersion Colloidal dispersions: Types of colloidal dispersions (Lyophobic, Lyophilic, Association colloids), Optical properties of colloids, Kinetic properties of colloids, Electrical properties of colloids, Size and shape of colloidal systems, Stability of colloidal system (peptization and protective action), Application of Colloidal System.
- Coarse Dispersions: Suspensions, Stokes law (Theory of sedimentation), Effect of Brownian movement / Sedimentation of flocculated particles, sedimentation parameters. Flocculation and controlled structure flocculation. Theories of emulsification and stabilization (DLVO Theory, Monomolecular adsorption, Multimolecular adsorption, Film formation, Solid particle adsorption). Physical instabilities of emulsions (creaming, coalescence and breaking, and phase inversion).

Unit IV

- Rheological studies Newtonian systems and non-Newtonian systems. Thixotropy - measurement / Bulges and spurs. Negative thixotropy, Determination of rheological properties (Viscometers / single and multi-point).
- Viscoelasticity, psycho-rheology. Applications of rheology in pharm.

Unit V

- Micromeritics
- Particle size and size distribution, Particle Shape and Surface area:
- Methods for determination and significance. Flow properties of powders: determination, significance and methods of enhancement. Advanced flow properties of powders (Powder flow tester).

Practical

- Determination of surface tension of given liquids by drop count method and drop weight method.
- Determination of critical micellar concentration (CMC) of surfactants.
- Determination of viscosity of liquids using Ostwald's viscometer and Brookfield viscometer.
- Determination of HLB value of a surfactant.
- Calculation of isotonicity by different methods (Sodium Chloride Equivalent Method).
- Determination of particle size and particle size distribution using sieving method.
- Determination of particle size and particle size distribution using microscopic method.
- Determination of densities and derived properties of powders (bulk density, tapped density, Hausner ratio, Carr's compressibility index), true density, and porosity.
- Determination of angle of repose and influence of glidants on angle of repose.
- Determination of solubility of a drug at different pH/buffer systems at room temperature.
- Determination of partition coefficient of a drug in n-octanol and water system.
- Determination of partition coefficient of a drug in benzene and water system.
- Determination of critical solution temperature and composition of phenol-water system.
- Determination of specific surface area of charcoal by adsorption of acetic acid on activated charcoal.
- Determination of buffer capacity at various stages of titration of a weak acid against a strong base and determination of pKa.
- Note: Compare the values of various physicochemical properties with marketed formulations wherever possible.

BP212P SEC1 - Communication Skills

Elective Practical

- Introduction to Communication in Pharmacy
- Types of communication: verbal, non-verbal, written
- Importance in clinical, academic, and retail pharmacy
- Listening and Observation Skills Workshop
- Active listening techniques, barriers to listening
- Observation of cues: patient posture, tone, compliance
- Role-play: Communicating with a Patient for Dispensing a Prescription
- Explanation of dosage, frequency, side effects, and precautions
- Role-play: Handling Difficult Conversations (e.g., Angry Patient or Confused Elderly)
- Empathy, patience, tone modulation, de-escalation techniques
- Written Communication I: Professional Email Writing & Documentation
- Writing emails to doctors, suppliers, institutions
- Structure, etiquette, and clarity in pharmacy communications
- Written Communication II: Preparing Patient Information Leaflets and Drug Labels
- Use of simple language, drug facts, precautions, icons
- Creating flyers for common conditions (e.g., diabetes, asthma)
- Non-verbal Communication Skills
- Body language, eye contact, gestures, tone of voice
- Cross-cultural sensitivity in pharmacy communication
- Presentation Skills I - Basic Techniques
- Voice projection, clarity, use of visuals
- Individual practice with simple pharmacy topics
- Presentation Skills II - Group Presentations
- Topics: health awareness campaigns, drug education, OTC safety
- Patient Counseling Practice (Case-Based)
- Counseling for chronic illness (e.g., hypertension, diabetes)
- Role-playing real-life counseling situations
- Communicating with Healthcare Professionals
- Case handoff, drug information request, referral writing
- Using SBAR (Situation, Background, Assessment, Recommendation) format
- Mock Interview / Group Discussion Practice

- Industry/clinical job interview scenarios
- GD on topics like "Generic vs Branded Medicines"
- Digital Communication Skills for Pharmacists
- Creating a simple health blog, social media awareness post
- Basics of teleconsultation and ePharmacy chat support
- Ethics and Professionalism in Communication
- Confidentiality, patient rights, informed consent
- Role-play ethical dilemmas in pharmacy
- Communication practice through presentations or counselling demonstrations.

BP212P SEC2 - Mental Well-Being, Stress and Conflict Management

Elective Practical

- Self-assessment of stress levels using Perceived Stress Scale (PSS)
- Journaling activity: Maintain a 7-day emotional diary
- Mindfulness breathing exercise and reflection
- Guided meditation session and feedback form
- Time management activity using Eisenhower Matrix
- Role-play exercise on workplace conflict resolution
- SWOT analysis of personal behavior and coping mechanisms
- Cognitive restructuring worksheet for negative thoughts
- Group discussion: "How do you respond to stress?"
- Conflict styles self-test (Thomas-Kilmann Conflict Mode Instrument)
- Visualization technique to reduce anxiety
- Progressive muscle relaxation practice
- Team activity: Building trust through icebreakers and communication
- Reflection report after practicing gratitude for 5 days
- Case study analysis: Conflict scenario in a healthcare/pharma setup

BP212P SEC3 - Fundamentals of Computer Operations

Elective Practical

- Basic operation and navigation of a computer operating system, including system settings and file explorer functions.
- Creating, renaming, organizing, moving, and deleting files and folders within a computer system.
- Preparing a structured academic or pharmacy-related report using a word-processing application with appropriate formatting, tables, headers, and page layout.
- Inserting equations, images, and formatted elements while preparing documents such as reports, notices, or certificates using document editing tools.
- Creating spreadsheets for pharmacy-related calculations such as dose calculations, inventory records, or sales data using spreadsheet applications.
- Applying basic spreadsheet formulas and functions such as summation, averaging, conditional calculations, and counting operations.
- Generating graphs, charts, and data visualizations from experimental or pharmaceutical data using spreadsheet tools.
- Preparing a short academic presentation (approximately five slides) using presentation software with text, images, and basic design elements.
- Performing effective internet browsing and academic search techniques using online scientific literature databases and search platforms.
- Writing and sending professional emails including file attachments, proper subject lines, and appropriate use of CC and BCC with correct communication etiquette.
- Introduction to digital systems used in pharmacy practice such as billing, inventory management, or prescription management through demonstration or simulation.
- Using cloud-based storage platforms for saving, organizing, and sharing academic or pharmacy-related files and data.
- Exploring digital health technologies such as pharmacy-related mobile applications or electronic health tools used in healthcare practice.
- Accessing and utilizing online learning platforms for professional education and course materials.
- Preparing and submitting digital assignments using word-processing, spreadsheet, or presentation tools.

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