PHARMACOLOGY

1. General Pharmacology

Introduction to Pharmacology- Definition, scope and source of drugs, dosage forms and routes of drug administration. Pharmacodynamics-Mechanism of drug action, Receptors, classification and drug-receptor interactions, combined effects of drugs, factors modifying drug actions.

Pharmacokinetics-Mechanism and principle of absorption, distribution, metabolism and excretion of drugs. Principles of basic and clinical pharmacokinetics. Pharmacogenetics. Adverse drug reactions.

Discovery and development of new drugs-Preclinical and clinical studies.

Detailed pharmacology including classification, mechanism of action and therapeutic uses of following classes:

2. Nerohumoral transmission in autonomic and central nervous system:

Neurohumoral transmission (Autonomic and somatic). Neurohumoral transmission in the C.N.S with special emphasis on Pharmacology of various neurotransmitters. Nitric oxide: Biosynthesis of nitric oxide and its physiological role. Therapeutic use of nitric oxide and nitric oxide donors. Clinical condition in which nitric oxide may play a part.

Peptides and proteins as mediators:

General Principal of peptide pharmacology Biosynthesis and regulation of peptides Peptide antagonists. Protein and peptide as drugs.

3. Pharmacology of peripheral nervous system

Parasympathomimetics, Parasympatholytics, Sympathomimetics, Sympatholytics, Ganglionic stimulants and blockers. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).

Local anesthetic agents. Drugs used in Myasthenia Gravis.

4. Pharmacology of central nervous System

General anesthetics. Alcohols and disulfiram. Sedatives, hypnotics and centrally acting muscle relaxants, Psychopharmacological agents: Antipsychotics, antidepressants, antianxiety agents, anti-manics and hallucinogens.

Anti-epileptic drugs. Anti-parkinsonism drugs. Nootropics.

Narcotic analgesics, drug addiction, drug abuse, tolerance and dependence.

5. Pharmacology of cardiovascular system

Introduction of hemodynamics and Electrophysiology of heart.

Anti-hypertensive drugs, Anti-anginal agents, Anti-arrhythmic drugs. Drugs used in congestive heart failure. Anti-hyperlipidemic drugs.

Drugs used in the therapy of shock. Haematinics, anticoagulants and haemostatic agents.

Fibrinolytics and antiplatelet drugs. Blood and plasma volume expanders.

6. Drugs acting on urinary system

Diuretics and anti-diuretics.

7. Drugs acting on Respiratory system

Anti-asthmatic drugs, Mucolytics and nasal decongestants, Anti-tussives and expectorants. Respiratory stimulants

8. Pharmacology of Endocrine system

Basic concepts in endocrine pharmacology. Hypothalamic and pituitary hormones. Thyroid hormones and antithyroid drugs, Parathormone, Calcitonin and vitamin-D. Insulin, oral hypoglycemic agents and glucagon. ACTH and corticosteroids. Androgens and anabolic steroids. Estrogens, progesterone and oral contraceptives. Drugs acting on the uterus.

9. Chemotherapy

General principles of chemotherapy. Sulphonamides and co-trimoxazole.
Antibiotics- Penicillins, cephalosporins, chloramphenicol, Macrolides, quinolones and fluoroquinolons,. Tetracyclines. Aminoglycosides and miscellaneous antibiotics. Chemotherapy of tuberculosis, leprosy, fungal diseases, viral diseases, AIDS, protozoal diseases, worm infections, urinary tract infections and sexually transmitted diseases. Chemotherapy of malignancy.

10. Autacoids and their Antagonists

Histamine, 5-HT and their agonists and antagonists.
Prostaglandins, thromboxane and leukotrienes. pentagastrin, cholecystokinin, angiotensin, bradykinin and substance P., analgesic, anti-pyretic, anti-inflammatory and anti-gout drugs.

11. Pharmacology of drug acting on the gastrointestinal tract

Antacids, anti-secretary and antiulcer drugs.
Laxatives and antidiarrheal drugs. Appetite stimulants and suppressants. Digestants and carminatives. Emetics and anti-emetics.

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12. Chronopharmacology

Definition of rhythm and cycles. Biological clocks and their significance leading to chronotherapy.

13. Immnopharmacology

Immunostimulants and immunosuppressants.

14. Vitamins & Minerals

Vitamin deficiency diseases and their management. Role of minerals in health & diseases.

15. Principles of toxicology

Definition of poison. General principles of treatment of Poisoning. Treatment of poisoning due to Heavy metals, insecticides, opioids and other addict forming drugs. Study of acute, sub-acute and chronic toxicity as per OECD guidelines (guidelines 420,423,425,407,408,451/452; only names and significance, detailed procedures and minute details are not expected).

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HUMAN ANATOMY & PHYSIOLOGY

1. Cell physiology

Cell, Cell junctions, transport mechanisms, homeostasis, ion channels, secondary messengers.

2. The Blood

Composition and functions of blood, RBC, WBC, platelets. Homeostasis, blood groups, mechanism of clotting. Introduction to disorders of the blood.

3. Gastrointestinal tract

Structure of the gastrointestinal tract, functions of its different parts including those of liver, pancreas and gallbladder, various gastrointestinal structures and their role in the digestion and absorption of food.

4. Respiratory System

Structure of respiratory organs, functions of respiration mechanism and regulation of respiration, respiratory volumes and vital capacity.

5. Autonomic nervous system

Physiology and functions of the autonomic nervous system. Mechanism of neurohumoral transmission in ANS.

6. Sense organs

Structure and physiology of eye (vision), ear (hearing), taste buds, nose (smell) and skin.

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7. Skeletal System

Structure and function of the skeleton. Articulation and movement. Disorders of bones and joints.

8. Central Nervous system

Functions of different parts of the brain and spinal cord. Neurohumoral transmission in the central nervous system, reflex action, electroencephalogram, specialized functions of the brain, cranial nerves and their functions.

9. Urinary System

Various parts Structure and functions of the kidney and urinary tract. Physiology of urine formation and acid-base balance. Brief Introduction to disorders of the kidney.

10. Endocrine Glands

Basic anatomy and physiology of pituitary, thyroid, parathyroid, adrenal glands and pancreas. Local hormones. A brief introduction to disorders of various endocrine glands.

11. Reproductive System

Structure and functions of male and female reproductive system. Sex hormones, physiology of menstrual cycle, and various stages of pregnancy and parturition.

12. Cardiovascular system

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Anatomy of heart and blood vessels, physiology of blood circulation, cardiac cycle, conducting system of the heart, heart sound, electrocardiogram, blood pressure and its regulation.

13. Lymphatic systemposition, formation and circulation of lymph. Spleen and its functions.

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PATHOPHYSIOLOGY

1. Basic principles of cell injury and adaptation

Causes, pathogenesis and morphology of cell injury, apoptosis and necrosis.

2. Basic mechanisms of inflammation and repair

Pathogeneses of inflammation. Chemical mediators in inflammation. Pathogenesis of chronic inflammation. Repair of wounds in the skin, factors influencing healing of wounds.

3. Disorders of fluid, electrolyte and acid-base balance

4. Disorders of homeostasis: white blood cells, lymphoid tissues, and red blood cells related diseases.

5. Immunopathology including amyloidosis

a) Host parasite Relationship: - normal microbial flora of human body, infection vs. disease, Pathogenicity vs. Virulence, Koch & Rivers Postulates, Reservoir of infection-sources of infection, Portals of Entry, Portals of exit, vectors of infection, communicability of disease, recognized symptoms of microbial disease, classification of immunity.

- External defense mechanism of host: Skin, Mucus membrane, chemical Secretions, naturally occurring microbial flora.
- Internal defense Mechanism: Inflammation, fever, natural killer Cells, Phagocytic Cells, Soluble mediators-complement Lymphokines, Interferons.

b) Immune response:

- Specific immunity & immune response
- Humoral immunity antibody response, mediators of Humoral immunity, basic

structure of antibody, antibody classes & functions, maturation of immune response, immunologic memory.

- Antigens: specificity & Immunogenicity, Natural vs. artificial Antigens, Soluble, cellular antigens, thymus independent antigen, adjuvant.
- Hypersensitivity and its types
- Cellular immunity: Transplantation immunity, Cellular immunity to viruses, Implications of T-cell response. Acquisition of specific immunity: Natural vs. Passive acquisition.

Mechanism of autoimmunity. Classification of autoimmune diseases in man. Transplantation and allograft reactions, mechanism of rejection of allograft. Acquired Immune Deficiency Syndrome (AIDS).

6. Infectious diseases

Hepatitis - Infective hepatitis.

Sexually transmitted diseases (syphilis, gonorrhea, HIV). Pneumonia, typhoid, urinary tract infections. Tuberculosis. Leprosy. Malaria. Dysentery (Bacterial and amoebic).

7. Neoplastic diseases

Disturbances of growth of cells. General biology of tumors, differences between benign and malignant tumors. Classification of tumors. Historical diagnosis of malignancy. Etiology and pathogenesis of cancer. Invasions, metastasis, patterns of spread of cancer. Environmental carcinogenesis.

8. Pathophysiology of common diseases

Parkinsonism. Schizophrenia. Depression and mania

Stroke (ischemic and hemorrhage). Hypertension. Angina. Myocardial infarction, CCF. Atherosclerosis.

Diabetes mellitus.

Peptic ulcer and inflammatory bowel disease. Cirrhosis and alcoholic liver diseases. Acute and chronic renal failure.

Asthma and chronic obstructive airway diseases.

9. Laboratory tests for Liver function tests and kidney function tests



BIOCHEMISTRY

1. Cell

Revision of ultrastructure of the cell, functions of various cellular constituents. Applications of biochemical principles to the pharmacy.

2. Carbohydrates

Types of carbohydrates, their functions, digestion, & absorption. Aerobic & anaerobic oxidation with energetics. Glycogenesis, glycogenolysis, & gluconeogenesis. Hexose monophosphate shunt [HMP shunt]. Diseases associated with carbohydrate metabolism.

3. Proteins

Different types of proteins. Their functions, digestion & absorption. Denaturation & its effect on biological activity. Renaturation of proteins. Urea formation, urea cycle, creatinine formation. Transamination & deamination. Proteins as enzymes.

4. Lipids

Different types of lipids. Their functions, digestion, absorption & metabolism. (Beta-Oxidation of fatty acids with energetics. Biosynthesis of cholesterol [from acetate], adrenocorticoids, androgens, progesterone, estrogens, & bile acids / salts. Ketone bodies, their formation & biochemical significance. Diseases associated with lipid metabolism.

5. Vitamins

Definition. Classification, structures [except B12] biochemical role, sources, daily requirements, & deficiency symptoms. Vitamins as co-factors in biochemical reactions.

6. Biological oxidations & reductions

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Oxidation-reduction systems in the body their role. Oxidative phosphorylation & Electron transport chain. Cytochromes & inhibitors of the same.

7. Enzymes

Classification & their various roles. Enzyme co-factors. Enzyme kinetics. Michaelis-Menton equation along with its transformations. Double reciprocal plot. Factors affecting enzyme action. Enzyme inhibition, competitive & non-competitive, & kinetics.

8. Nucleic acids

Different types of nucleic acids [NAs] & their composition. Purine & pyrimidine bases, sugars, & phosphoric acid. Nucleosides & nucleotides. Formation of NAs & their backbone. Different ways of representing DNA & RNA molecules. Physico-chemical properties of NAs. Their stability in acidic & basic solutions. Isolation, purification & identification, buoyant density, sedimentation coefficient, & Svedberg constant of NAs. De-novo biosynthesis of NAs. DNA & the Watson-Crick model & its features. DNA as the bearer of genetic information. The Central dogma of molecular genetics & the processes defined in the same. Replication of DNA. Different types of RNAs with their special features & functions. Minor or rare bases. Transcription & translation. Different post-translational modifications of proteins. Triplet codon & the codon dictionary. Mutations. An introduction to different types of mutations. Their nature & repair.

9. Hereditary diseases.

Eliptocytosis, spherocytosis, HNPCC, diabetes insipidus.

BIOTECHNOLOGY

1. Plant Cell and Tissue Culture

Structure of plant cell, DNA, Genes and chromosomes.

1. Cell and tissue culture,
    a. Requirements.
    b. Callus culture, suspension culture, batch culture.
    c. The concept of somatic hybridization, somatic embryogenesis.
2. Processes and applications,
    a. Isolation and immobilization of enzymes and plant cells and application.
    b. Protoplast and cell fusion.
    c. Germplasm conservation.
    d. Production of secondary metabolites by plant tissue culture.
    e. Gene transfer techniques.

2. Animal Cell Culture

Introduction to animal cell culture, medium used in ATC. Use of FCS, primary culture, secondary culture, cell line. Cloning: concept and application with technical hurdles. Transgenic animals as a source of food, organs and tissues, concept of xeno transplant.

3. Fermentation Technology and Industrial Microbiology

a) Fermentation as a biochemical process, types of fermentation.
b) Fermenter - working and construction, accessory components, modification.
c) Fermentation monitoring and in situ recovery of products.

4. Recombinant DNA Technology

Basic concepts

a) Introduction.

b) Role of a restriction endonuclease, DNA ligase, DNA polymerase, Reverse transcriptase.

5. Process and Applications

a) Constructing Recombinant DNA molecules. DNA Clones sources of DNA for cloning. DNA vectors, role of expression vectors.

- Host cell for recombinant work.
- Method for screening and selecting transformants.
- Expression of foreign genes. Uses of recombinant DNA.

b) PCR and applications. Human gene therapy concept and applications.

c) Drug delivery systems in gene therapy.

6. Biotechnology Derived Products

a) Sources and upstream processing. Introduction.

i. *Escherichia coli* as a source of recombinant, therapeutic protein. Additional production systems,

a. Yeast.

b. Fungal production systems.

c. Transgenic animals.

d. Transgenic plants.

e. Insects cell-based systems.

ii. Upstream processing.

b) Downstream processing.

i. Product analysis,

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a. Introduction.

b. Protein-based contaminant.

c. Removal of an altered form of the protein of interest from the product stream.

ii. Determination of protein concentration.

c) Immunological approaches to detection of contaminant, Endotoxin and other pyrogenic contaminants.

i. Pyrogen detection.

ii. DNA as a contaminant.

iii. Microbial and viral contaminant. Viral assays.

iv. Miscellaneous contaminants. Validation studies.

d) Production and purification of recombinant proteins like, Insulin, Growth hormones, somatostatin, interferons, only examples of recombinant blood products.

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MICROBIOLOGY

1. Introduction to Microbiology

Scope and application to pharmacy field. Whittaker's Five Kingdom concept, historical development - biogenesis Vs. abiogenesis, Germ theory of fermentation, Germ theory of disease, the contribution of Leeuwenhoek, Robert Koch, Jenner, Louis Pasteur and Ehrlich.

2. Microscopy and staining technique

The principle, ray diagram, construction, working and applications of light compound, dark field, phase contrast, Fluorescence & electron microscope. The concept of resolving power, Magnification power, numerical aperture and angular aperture and working distance. The principle application of oil immersion microscopy. Theory of staining, principle and technique of staining procedure - Monochrome, Gram, acid-fast, negative, capsule, endospore.

3. Biology of Microorganisms

Cultural characteristics, pure culture techniques

a) Bacteria - Morphology and fine structure of bacteria, Nutritional requirement and type of culture media, growth and growth curve of bacteria, physical condition for growth, measurement of bacterial growth (Counting Methods), Reproduction in bacteria, genetic exchange - transformation, conjugation, and transduction, development of drug resistance by recombination and mutation, preservation of bacterial culture. Biochemical properties (sugar fermentation and IMVIC test). Pathogenesis of *Staphylococcus*, *Mycobacterium*. *Salmonella*. Introductory study of disease-causing rickettsia, the importance of actinomycetes in antibiotic

production.

4. Fungi and Viruses

b) Fungi: - Introduction, general characteristics, morphology, the industrial and medical significance of *Saccharomyces Cerevisae*, *Penicillium* and *Aspergillus*, *Candida albicans*, Epidermophyton, and trichophyta.

c) Viruses: - Introduction, structure and general properties Bacteriophages - Lytic and Lysogenic cycle, Epidemiological uses of Bacteriophages, human viruses - Cultivation and Multiplication virus-host cell interaction, Pathogenesis of HIV and Prions, types of Tumor viruses.

5. Aseptic Technique

The omnipresence of microorganisms, the importance of asepsis, sources of contamination and methods of prevention, Principle, construction & working of laminar airflow bench.

6. Sterilization & Disinfection

a) Concept and classification, principle and methods of sterilization, Mechanisms of cell injury.

b) Construction working & applications of moist heat & dry heat sterilizer, gamma radiation sterilizer, filtration sterilizer. Indicators of sterilization, microbial death, kinetic terms-D value, z value.

c) Terminology of chemical antimicrobial Agents, Chemical classification of different disinfectants, characteristics of ideal disinfectants, factors affecting the action of disinfectants, evaluation methods (RW Coeff.), Kelsey Sykes test, Chick Martin test.

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7. Microbial spoilage

Types of spoilage, factors affecting spoilage of pharmaceutical products.

8. Vaccines & Sera

Manufacturing (seed lot system) and quality control of bacterial vaccines & Toxoids (Tetanus, TAB, Cholera, BCG, DPT), Viral vaccine (Polio- Salk Sabin, Rabies, MMR, Hepatitis, Chickenpox, influenza), Antisera (diphtheria, tetanus), antiviral Antisera (rabies). Preparation of allergenic extracts & diagnostics.

9. Microbial Assay

Importance, general methods of assay of antibiotics (Cup & plate method, paper disc method, turbidometry, dilution method), methods for fungicidal & antiviral compounds, assay, microbial limit tests.

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BIOPHARMACEUTICS AND PHARMACOKINETICS

1. Bio-pharmaceutics

a) The fate of drug after drug absorption, various mechanisms for drug absorption, drug concentration in blood, biological factors in drug absorption, physicochemical factors, dosage form consideration for gastrointestinal absorption.

b) Drug Absorption:

- Gastrointestinal absorption-biological considerations.
- Gastrointestinal absorption - physicochemical considerations.
- Gastrointestinal absorption-role of the dosage form.

c) Pharmacokinetics. Compartmental and non-compartmental pharmacokinetics. Biotransformation, drug disposition - distribution, drug disposition - elimination. Variability-Body weight, age, sex and genetic factors. Pharmacokinetic variability-diseases. Pharmacokinetic variability-drug interactions. Individualization and optimization of drug dosing regimens.

2. Bio-availability & Bio-equivalence

Quality parameters of dosage forms. Assay methods & its validation.

Physicochemical properties of drugs & added substances and its effect on preparations and biological availability of dosage forms. Pharmaceutical properties of dosage forms, disintegration, dissolution rate. Biological, pharmacological effects of dosage forms. Factors affecting Bioavailability, Determination of bioavailability.

Significance of bio-equivalence studies. Statistical analysis of bioequivalence studies. Development, scale up & post approval changes [SUPAC] & *in vitro* [dissolution] *in vivo* [plasma concentration profile] correlation or IV/IV correlation (IVIVC). Multi stage - Bioequivalence studies. Therapeutic equivalence. Titration design for clinical rationales.

New Drug Application [NDA].

3. Bio- pharmaceutical statistics

Post Marketing Surveillance. Process Validation.

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CLINICAL PHARMACY AND THERAPEUTICS

1. General Principles, preparation, maintenance, analysis of observational records in clinical Pharmacy.
2. Clinical trials, type and phases of clinical trials, placebo, ethical and regulatory issues including Good clinical practice in clinical trials.
3. Therapeutic drug monitoring, adverse drug reaction (ADR), types of ADR, Mechanism of ADR. Drug interaction, Monitoring and reporting of ADR and its significance.
4. Drug information services, Drug interactions.
5. Drug interaction in pediatric and geriatric patients, drug treatment during pregnancy, lactation and menstruation.
6. Pharmacovigilance, Therapeutic drug monitoring, Neutraceuticals, essential drugs and rational drug usage.
7. Age-related drug therapy: concept of posology, drug therapy for neonates, pediatrics and geriatrics. Drugs used in pregnancy and lactation.
8. Drug therapy in gastrointestinal, hepatic, renal, cardiovascular and respiratory Disorders.
9. Drug therapy for neurological and psychological disorders.
10. Drug therapy in infections of respiratory system, urinary system, infective meningitis, TB, HIV, malaria and filaria.
11. Drug therapy for thyroid and parathyroid disorders, diabetes mellitus, menstrual cycle disorders, menopause and male sexual dysfunction.
12. Drug therapy for malignant disorders like leukemia, lymphoma and solid tumors.
13. Drug therapy for rheumatic, eye and skin disorders.

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