

# **STUDY GUIDE**

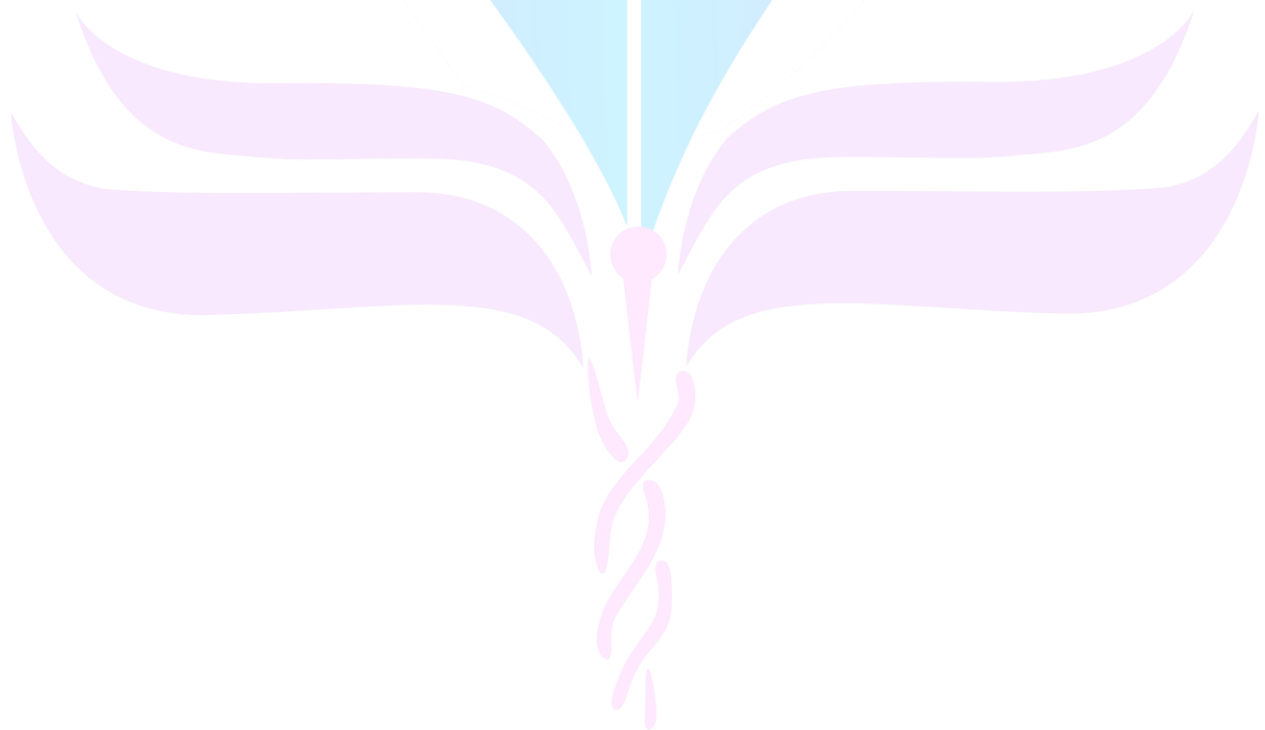
# **PHARMACOLOGY**



**STUDY GUIDE FOR  
THIRD YEAR  
PHARMACOLOGY  
(2019-2020)**

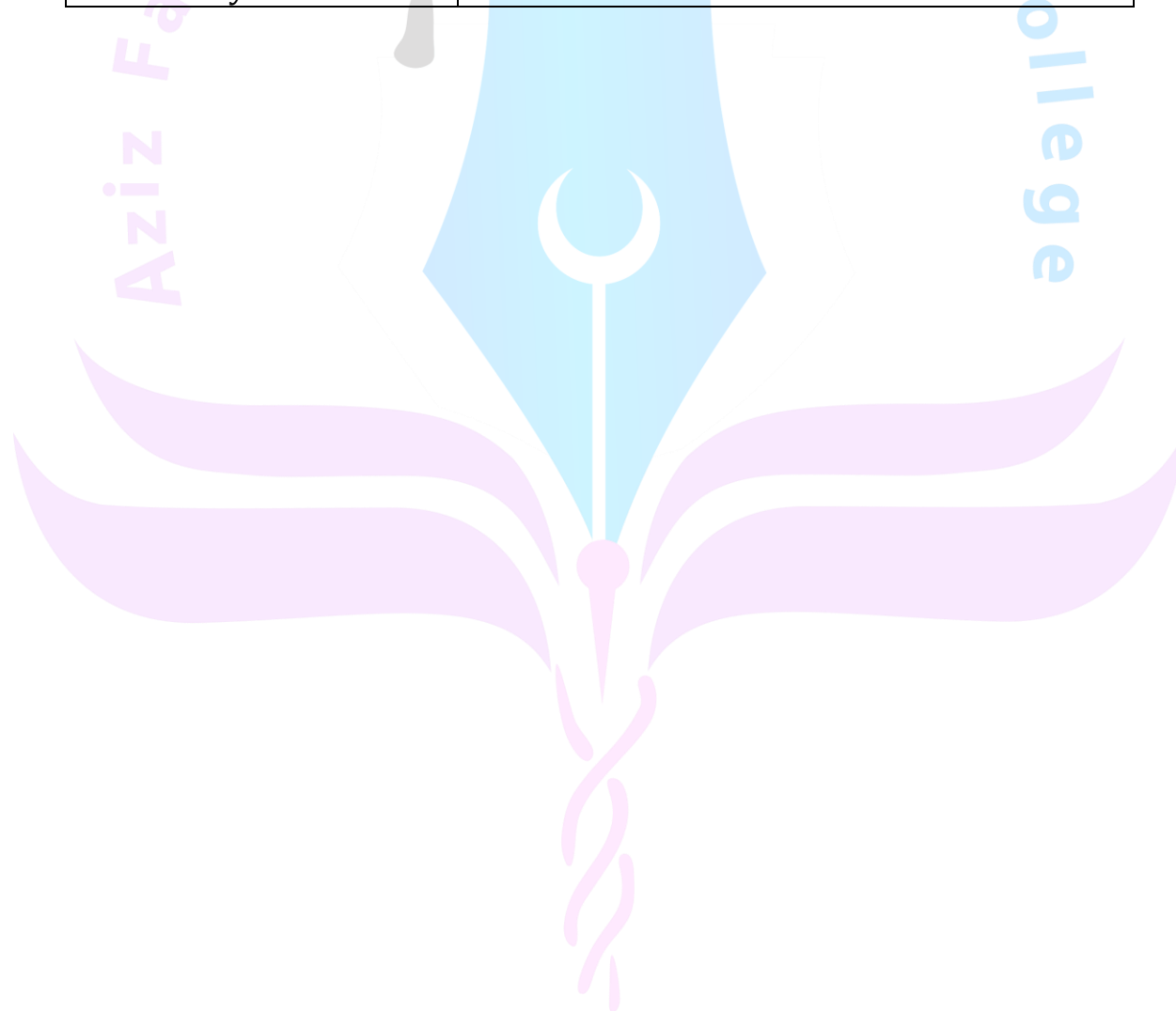
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## PHARMACOLOGY DEPARTMENT TEAM - AFMDC

Positions	Name
Head of Department	Prof. Dr. Farida Qadir (MBBS, M Phil, PhD)
Assistant Professor	Dr. Sarwat Jahan (MBBS, M Phil)
Assistant Professor	Dr. Iram Akram (MBBS, M Phil)
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Pharmacist	Ramsha Abbas (Pharm D, M Phil)
Computer operator	Mr. Aamir Hussain
Laboratory attendant	Mr. Habib ur Rahman



## INTRODUCTION TO PHARMACOLOGY

Pharmacology is one of the basic sciences that forms the foundation for medical practice. It describes how drugs interact with the human body at the molecular, cellular, and tissue levels to elicit their effects (pharmacodynamics) and how body absorbs, distributes, metabolizes and eliminates drugs (pharmacokinetics). General concepts of pharmacology are grounded in the foundational sciences of physiology, genetics, biochemistry and anatomy. Pharmacology forms a bridge between the foundational and clinical sciences where the application of the principles of pharmacology becomes the foundation for therapeutics. The value of pharmacology is to ensure a scientific basis for therapeutic decisions and the evaluation of benefit versus risk based on an understanding of the pharmacodynamics and pharmacokinetics of drugs.

**Learning Outcomes:** Education in pharmacology is divided into two phases. The first phase includes the development of a solid knowledge base of the major classes of therapeutic agents. In the second phase, students are exposed to clinical situations in which they explain the pharmacological basis for their drug of choice, what possible adverse effects to anticipate and common drug interactions in case of polypharmacy. This finally leads an understanding of the scientific methods of evaluating the benefits and risks of drugs which is the core concept of pharmacology as a foundational science.

**Goals of Pharmacology:** The broad goal of the teaching of Pharmacology to undergraduate students is to inculcate a rational and scientific basis of use of therapeutic agents in treatment of diseases. To instill the practice of critical thinking and develop interest in learning through the latest evidence based treatment guidelines and research into new pharmaceutical agents.

## TEACHING/ LEARNING METHODOLOGIES

The comprehensive teaching plan is designed according to the UHS and PM&DC syllabi and guidelines to direct the students towards achievement of the desired goals.

- **Lectures:** This comprises of lecture sessions in which the instructor uses traditional teaching techniques using multimedia interspersed with interactive sessions to help students acquire clear concepts of the learning objectives.
- **Tutorials:** The students will also be exposed to small group discussions during the tutorial sessions in which they will come prepared after having read through the topics covered in the lectures. The learning objectives for the tutorial sessions in the week to follow will be posted on the department notice board on Thursday–Friday of the preceding week to give students ample time during the weekend to thoroughly prepare the topic. Instructors will clarify and explain any difficulties in understanding the concepts and identify and fill any gaps in knowledge. The last 15 minutes of each class will comprise of a small quiz to help assess how much the student has benefited from the discussion. 5 marks will be allocated for performance/participation during discussions and 5 marks for the quiz.
- **Practical Sessions:** The course of the practical sessions has been designed in line with UHS/PMDC syllabi. In the portion of experimental pharmacology, some of the keys pharmacological concepts learnt in theory classes will be demonstrated and performed using animal experiments. The students will also be exposed to common clinical case scenarios in which they will learn to diagnose the case and write a suitable prescription based on the recent treatment guidelines and also keeping in view the doses required, the duration of treatment and drug interactions in mind. The pharmacy section of the course will enable students to prepare and dispense some commonly used solutions, creams, ointments and lotions.
- **Class Discussions:** A 90 minutes time slot every month has been allocated to class discussion where the students are given a feed-back on their monthly test performance. They are guided on the proper approach to solving MCQs and short essay questions. Whenever required students are

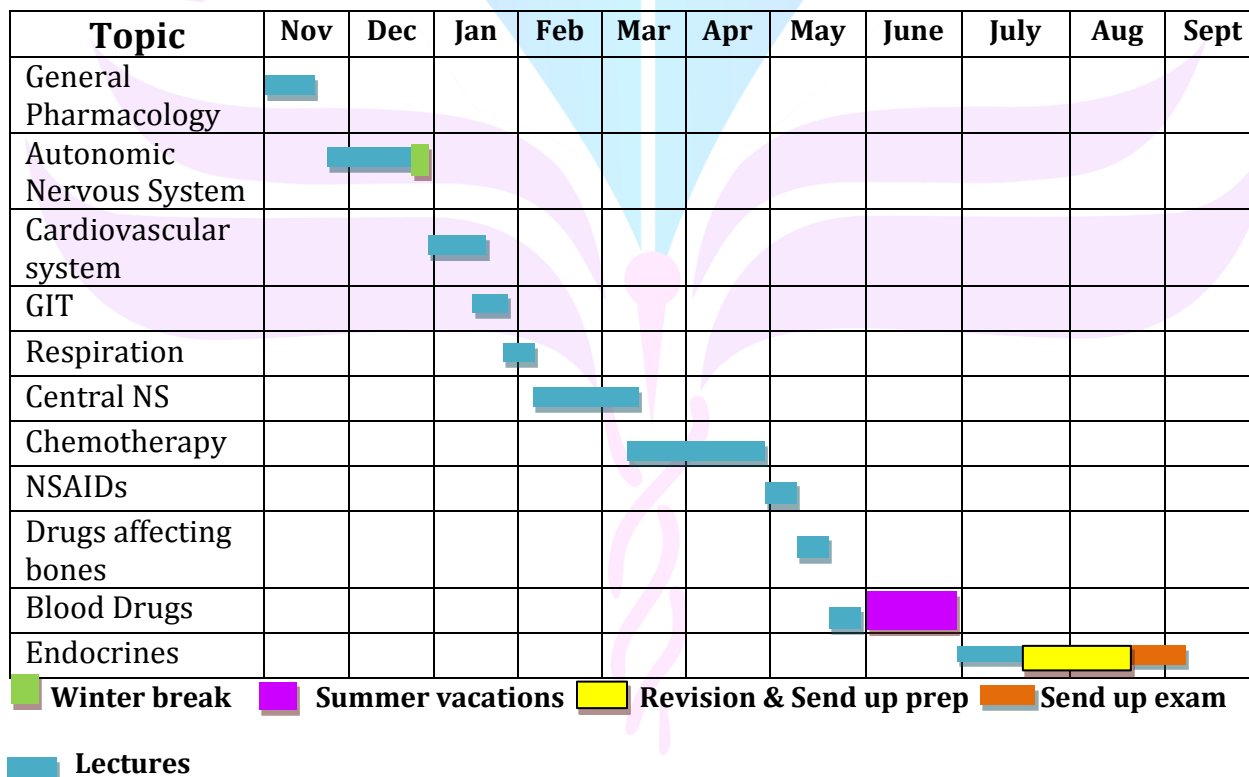
divided in small groups to help, guide and explain to each other some allocated topics. Instructors are present guide the course of discussions.

### Time-Table 3<sup>rd</sup> Year Pharmacology

Day	1	2	3	4	5	6	7
	08:00-08:45	08:45-9:30	09:30-10:15	10:15-11:00	11:00-13:00	13:00-13:30	13:30-15:00
Monday	Monthly test (3 <sup>rd</sup> week)				Practical	Zohr break	Practical
Tuesday			Lecture				Practical
Wednesday		Lecture					Tutorial
Thursday		Lecture			Tutorial		Discussion
Friday	08:00-08:45	08:45-09:30	09:30-10:15	10:15-11:00	11:00-13:00	13:00-14:00	14:00-15:00
			Lecture		Tutorial	Jumma break	Self-study

### TIME LINE for SYLLABUS COMPLETION

#### THIRD YEAR LECTURES



## ASSESSMENT METHODOLOGIES

Regular assessments both formative and summative are made throughout the year in order to evaluate achievement of learning objectives, identify weaknesses and difficulties and improve instructional designs. The assessment tools are based on table of specifications from UHS in order to give students ample practice and confidence while attempting the final exams.

- **Short quizzes** comprising multiple short questions and brief answers at the end of each tutorial class.
- Evaluation of participation/performance during the tutorial sessions.
- **Monthly tests** of 90 minutes duration, conducted every month on the unit covered previously. This will be on the MCQ and short essay format.
- **Send up Exams (theory)** at the end of the academic year covers all the units included in the syllabus. It is a mock exams designed on the pattern of the final professional exams.
- **Send up Exams (practical)** are conducted following the send up theoretical exams and comprise of unobserved OSPE (7 stations), performance of observed experimental and pharmacy practical and an oral viva test.

Marks allocated during the send up tests follow the same pattern of distribution as provided in ToS of UHS. **Attaining least 50% marks are mandatory in order to qualify for admission to UHS final exams.**

- Students are required to maintain a **Practical Journal of Pharmacology** which they complete during the practical classes and have it checked and signed by the instructor. 5 marks are allocated to the journal.

### **Calculation of Internal Assessment**

- Monthly assessment (100marks) = 15 marks for tutorials + 10 marks for attendance + 75 marks monthly test
- Internal assessment sent to UHS is for **30 marks** which includes 12 (40%) marks calculated from average monthly assessment results + 18 (60%) marks calculated from send-up exam results.

## UHS 3<sup>rd</sup> Professional Exams

### ToS Pharmacology (Theory Paper)

Topic	SEQs	MCQs
General Pharmacology	01	05
ANS and Neuromuscular Blockers	01	05+01
CVS, Diuretics and Blood Drugs	1.5	10
CNS	01	06
Autacoids, NSAIDs, Antigout, Antirheumatic	01	06
Antimicrobial and antibiotics in general use	01	10
Antimycobacterial, Antiprotozoal, Antihelminth	01	06
Antineoplastic, Antiviral, Antifungal, Dermatological drugs	0.5	05
GIT	0.5	03
Respiratory	0.5	02
Endocrine, Uterus	01	06
	<b>Total 10</b>	<b>Total 65</b>

Total SEQs = 10 X 7 marks each = 70 marks, Time 2 hours (12 minutes each question). Attempt all questions. All questions carry equal marks.

Total MCQs = 65 X 01 mark each = 65 marks. Time 1 hour, Type 1 best of five

### UHS Marks Distribution for Theory Exams

Theory Total 150		
SEQs	MCQs	Internal Assessment
10 X 7 = 70	1 X 65 = 65	15



## ToS FOR OSPE (UNOBSERVED STATIONS)

### Pharmacology & Therapeutics (OSPE)

OSPE Stations & Marks			
Station No.	Station Category	Marks	Time (Min.)
<b>Non-Observed Stations (Total Marks-35)</b>			
1	Pharmacy Calculations	5	4
2	Dose Calculations	5	4
3	Abbreviations/Theory Related Questions	5	4
4	Prescription Writing	5	4
5	P-Drug	5	4
6	Abbreviations/Theory Related Questions	5	4
7	Biostatistics	5	4
<b>Observed Stations (Total Marks-35)</b>			
1	Experimental Pharmacology (Including Table Viva)	20	
2	Pharmacy Practice (Including Table Viva)	15	

### UHS Marks Distribution for Practical Exams

Practical Total 150						
Viva external	Viva internal		OSPE (Unobserved)	Observed		Internal assessment
		Journal		Pharmacy	Experimental	
30	30	5	7 stations X 5 = 35 marks	15 marks	20 marks	15

# **LEARNING OBJECTIVES OF PHARMACOLOGY**

## **THIRD YEAR M.B.B.S**

### **UNIT I GENERAL PHARMACOLOGY**

#### **PHARMACOKINETICS**

##### **1. Topic : Routes of Drug Administration**

- At the end of this session you should be able to:
- 1. Define pharmacokinetics and pharmacodynamics
- 2. List the pharmacokinetic drug parameters
- 3. Explain the purpose of studying pharmacokinetics of drugs
- 4. Define first-pass effect and explain the sites of first-pass metabolism
- 5. Classify the different routes of drug administration
- 6. Explain the advantages and disadvantages of the different routes with few examples of drugs administered by these routes

##### **2. Topic: Drug Absorption**

- At the end of the session students should be able to:
- 1. Define bioavailability
- 2. Calculate bioavailability
- 3. Define bioequivalence, therapeutic equivalence, pharmaceutical equivalence
- 4. Explain the physical and chemical characteristics of drugs that modify absorption/bioavailability.
- 5. Discuss physiological and pathological factors that modify drug absorption/bioavailability.
- 6. Explain the effect of drug ionization on absorption, distribution and excretion of drugs
- 7. Define pKa value of drugs and explain the relationship of pH and pKa to drug ionization
- 8. Describe the phenomenon of "ion-trapping". Give some examples of its clinical implications

##### **3. Topic: Drug Distribution**

- At the end of the session you should be able to:
- 1. Define drug distribution and apparent volume of distribution
- 2. Calculate  $V_d$
- 3. Explain the different body compartments and pattern of drugs distribution between these compartments.
- 4. Explain the factors that determine the distribution of a drug
- 5. Describe plasma protein binding of drugs and its significance in drug interaction
- 6. Define drug redistribution with examples

##### **4. Topic: Drug Metabolism**

- At the end of the session students should be able to:
- 1. Define drug elimination, drug biotransformation

2. Describe the purpose of drug metabolism
3. List the sites of drug metabolism
4. Explain the stages of drug metabolism
5. Discuss the role of CYP-450 enzyme system in drug biotransformation
6. Describe the factors that modify biotransformation of drugs
7. Explain hepatic enzyme induction, inhibition and genetic polymorphism and their discuss their clinical implication

### **5. Topic: Drug Excretion**

- At the end of the session students should be able to:
  1. Define drug excretion
  2. List routes of excretion
  3. Explain processes involved in renal excretion, Ion trapping, High and low renal clearance
  4. Explain: Biliary excretion, Pulmonary excretion, Mammary excretion
  5. Discuss drug Clearance

### **6. Topic: Clinical Pharmacokinetics**

- At the end of this session students should be able to:
  1. Explain 1<sup>st</sup> order and zero-order elimination kinetics
  2. Draw graph of plasma concentration versus time for zero and 1<sup>st</sup> order elimination
  3. Compare 1<sup>st</sup> order and zero-order elimination kinetics
  4. Calculate change in plasma concentration of drugs at various times after administration
  5. Define half-life of a drug and explain the relationship between  $t_{1/2}$ ,  $V_d$  and  $CL$
  6. Calculate the half-life of a drug from  $t_{1/2}$  and  $V_d$  values
  7. Name conditions that can increase or decrease  $t_{1/2}$
  8. List the different types of drug dosage regimens
  9. Define steady-state drug concentration ( $C_{ss}$ )
  10. Explain the effect of change in rate of administration on  $C_{ss}$
  11. Calculate loading dose and maintenance dose of drugs
  12. Explain the purpose of giving loading dose

## **PHARMACODYNAMICS**

### **7. Topic: Drug Receptors**

- At the end of this session students should be able to:
  1. Define pharmacodynamics and explain the purpose of studying pharmacodynamics of drugs
  2. Enumerate drug receptor super families with examples of each type
  3. Explain details of signal transduction mechanisms of G-protein coupled receptors, ligand gated ion channels, intracellular receptors and enzyme linked receptors
  4. Explain: Affinity, efficacy, agonists, antagonists
  5. Describe different types of agonists
  6. Describe types of drug antagonists with examples

### **8. Topic: Quantitative Pharmacodynamics**

- At the end of this session students should be able to:

1. Explain the two types of Dose-Response-Curves
2. Explain the information obtained from graded D-R-C and quantal D-R-Cs
3. Define drug potency and explain its importance
4. Compare the potency and efficacy of drugs from their dose-response curves
5. Recognize the D-R-C of different types of drug agonists
6. Recognize the D-R-C of agonist in presence of reversible and irreversible antagonists
7. Define and calculate therapeutic index and explain its importance
8. Define therapeutic window and explain its importance
9. Explain the concept of spare receptors.

### **9. Topic: Adverse Drug Reactions**

- At the end of this session students should be able to:
  1. Explain the terms: drug tolerance, tachypylaxis, anaphylaxis and idiosyncratic drug reactions with examples of each.
  2. Discuss teratogenic effects of drugs
  3. Explain drug dependence and drug withdrawal effects

### **10. Topic Drug Interactions**

- At the end of this session students should be able to:
  1. Define drug interaction and explain the consequences of drug interactions
  2. Classify the pharmacokinetic and pharmacodynamics drug interactions
  3. Explain with examples: drug synergism, potentiation, additive effect and antagonism
  4. Discuss with examples pharmacokinetic drug interactions at the level of absorption, distribution, metabolism and excretion
  5. Discuss physiological, chemical and pharmacological drug antagonism.
  6. Give some examples of drug-food interactions

## **UNIT II AUTONOMIC NERVOUS SYSTEM**

### **1. Topic: Introduction to ANS**

- At the end of this session students should be able to:
  1. Describe the organization of the nervous system
  2. Name the location of adrenergic and cholinergic neurons.
  3. Explain the neurotransmitters in ANS and how norepinephrine and acetylcholine are synthesized, released and degraded
  4. Explain how drugs can influence synthesis, storage, release and metabolism of acetylcholine and norepinephrine
  5. Classify the cholinergic receptors and explain their location, signal transduction mechanism and effect of activation of these receptors
  6. Classify the adrenergic receptors and explain their location, signal transduction mechanisms and effects of activation of these receptors

### **CHOLINERGIC DRUGS**

### **2. Topic: Cholinergic Agonists**

- At the end of this session students should be able to:

1. Classify cholinergic agonist drugs
2. Describe the systemic effects of cholinergic agonists
3. Describe the uses, adverse effects and contraindications to use of cholinergic agonists
4. Compare physostigmine and neostigmine
5. Describe the signs and symptoms and treatment of organophosphorus compound poisoning
6. Name drugs used in treatment of glaucoma, Alzheimer's disease and myasthenia gravis and the rationale for their use in these conditions

### **3. Topic: Muscarinic Receptor Blocking Drugs**

- At the end of this session students should be able to:
1. Classify cholinergic antagonists with examples of selective and some nonselective muscarinic blockers.
  2. Describe the mechanism of action of muscarinic blocking drugs
  3. Describe the systemic effects of antimuscarinic drugs
  4. Name the uses of antimuscarinic drugs and know the rationale for these indications.
  5. Describe adverse effects of muscarinic antagonists
  6. Describe the signs and symptoms and treatment of atropine poisoning

### **4. Topic: Nicotinic Receptor Blockers (Neuromuscular Blocking Drugs)**

- At the end of this session students should be able to:
1. Classify the neuromuscular blocking agents (NMBAs).
  2. Discuss the mechanism of action of competitive and depolarizing NMBAs.
  3. Mention uses of NMBAs
  4. Discuss the adverse effects of competitive and depolarizing NMBAs
  5. Explain malignant hyperthermia and prolonged apnea produced by succinylcholine
  6. Discuss drug interactions of NMBAs
  7. Name the centrally acting muscle relaxants, their mechanism of action and uses

### **5. Topic: Nicotinic Receptor Blockers (Ganglion Blocking Drugs)**

- At the end of this session students should be able to:
1. Classify ganglion blockers and explain their systemic effects, use and adverse effects

## **ADRENERGIC DRUGS**

### **6. Topic: Adrenergic Agonists**

- At the end of this session students should be able to:
1. Classify sympathomimetic drugs based on their chemical structure
  2. Compare catecholamines and noncatecholamines
  3. Classify sympathomimetic drugs based on receptor affinity with examples of each group
  4. Describe the systemic effects of epinephrine, norepinephrine, isoproterenol
  5. Compare the effects of epinephrine, norepinephrine and isoproterenol on cardiovascular system

6. Discuss the clinical uses of epinephrine, norepinephrine and isoproterenol with rationale for their use
7. Discuss the adverse effects of epinephrine and contraindications to its use
8. Describe the dose-dependent effect of dopamine on cardiovascular system and list the clinical indications for use of dopamine
9. Describe the important characteristics of – selective  $\alpha_1$  agonists, selective  $\alpha_2$  agonist (clonidine), selective  $\beta_1$  agonist, selective  $\beta_2$  agonists
10. Describe the important features of indirectly acting sympathomimetic drugs – amphetamine, ephedrine
11. Discuss shock – types and management

### **7. Topic $\alpha$ -Blocking Drugs**

- At the end of this session students should be able to:
  1. Classify  $\alpha$  blocking drugs
  2. Describe systemic effects of  $\alpha$  blockers
  3. List uses of  $\alpha$  blockers and give the rationale for use in these conditions
  4. Explain adverse effects of  $\alpha$  blockers
  5. Name contraindications to use of  $\alpha$ -blocking drugs

### **8. Topic $\beta$ -Blocking Drugs**

- At the end of this session you should be able to:
  1. Classify  $\beta$  blocking drugs
  2. Describe the systemic effects of  $\beta$  blockers
  3. Explain the uses of  $\beta$  blockers
  4. Explain the beneficial effects of  $\beta$  blockers in hypertension, cardiac failure and arrhythmias
  5. Describe the adverse effects of  $\beta$  blocking drugs
  6. Explain the conditions in which  $\beta$  blockers are contraindicated/ used with caution

### **9. Topic Adrenergic Neuron Blockers**

- At the end of this session you should be able to:
  1. Name the adrenergic neuron blocking drugs
  2. Describe important characteristics of:  $\alpha$  methyl dopa, reserpine, guanetidine, bethanidine

## **UNIT III CENTRAL NERVOUS SYSTEM**

### **1. Topic: Introduction to CNS**

- At the end of this session students should be able to:
  1. Define neurotransmitters, neuromodulators, neurotropic agents.
  2. List the criteria defining a neurotransmitter
  3. Name the important excitatory and inhibitory neurotransmitters in brain and describe their mechanisms of action
  4. Relate the disturbances in neurotransmitters to disease conditions
  5. Describe the effects of CNS stimulant and CNS depressant drugs

### **2. Topic: Anxiolytic, Sedative, Hypnotic Drugs**



- At the end of this session students should be able to:
- 1. Classify major anxiolytic, sedative, hypnotic drugs
- 2. Describe the mechanism of action of benzodiazepines, barbiturates, buspirone and zolpidem, zaleplon
- 3. Describe the systemic effects of benzodiazepines and relate these to clinical uses of benzodiazepines
- 4. Compare benzodiazepines with barbiturates
- 5. List the important uses of sedative, hypnotics and their adverse effects
- 6. Describe the treatment of benzodiazepine, barbiturate overdose

### **3. Topic: Local Anesthetics**

- At the end of this session students should be able to:
- 1. Classify local anesthetics
- 2. Tabulate the differences between esters and amides group
- 3. Explain the mechanism of action of local anesthetics
- 4. Discuss the factors affecting onset and duration of action of local anesthetics (with emphasis on effect of pH and pKa values)
- 5. Discuss local anesthetic toxicity
- 6. Explain the techniques for administration of local anesthetics

### **4. Topic: General Anesthetics**

- At the end of this session students should be able to:
- 1. Classify of general anesthetics
- 2. Explain the mechanism of action of general anesthetics
- 3. List the properties of an ideal inhalation anesthetic
- 4. Discuss the factors governing the onset and duration of general anesthetics with particular reference to blood:gas partition coefficient and oil:gas partition coefficient
- 5. Define MAC value and discuss the importance of this value
- 6. List the pre-anesthetic medications and give the rationale for their use
- 7. Explain the systemic effects and adverse effects of the inhalation and IV general anesthetics
- 8. Compare halothane and nitrous oxide
- 9. Define neuro-lept anesthesia and conscious sedation

### **5. Topic: Antidepressant Drugs**

- At the end of this session students should be able to:
- 1. List the affective disorders and describe the signs and symptoms of depression.
- 2. Explain the neurotransmitter theories of depression
- 3. Classify antidepressant drugs
- 4. Explain the mechanism of action of each class of antidepressants
- 5. Describe the adverse effects of each class of antidepressant drugs
- 6. List uses of antidepressants in disorders other than depression

### **7. Topic: Antipsychotic Drugs**

- At the end of this session students should be able to:
- 1. Describe the signs and symptoms of schizophrenia

2. Explain the neurotransmitter theories of psychosis
3. Classify antipsychotic drugs
4. Differentiate between 'typical' and 'atypical' antipsychotic drugs
5. Differentiate between high and low potency typical antipsychotics
6. Describe the extrapyramidal symptoms produced by antipsychotics and their treatment
7. Explain neuroleptic malignant syndrome and its treatment
8. Describe characteristics of: clozapine, olanzapine, risperidone, quetiapine, ziprasidone, aripiperazole
9. List other clinical uses of antipsychotic drugs
10. Classify drugs used in treatment of bipolar disorders
11. Explain the mechanism of action of lithium
12. Discuss the adverse effects of lithium

### **8. Topic: Antiepileptic Drugs**

- At the end of this session students should be able to:
  1. Classify seizure disorders and describe the sign and symptoms of grand mal, petit mal, and myoclonic seizures
  2. Classify antiepileptic drugs and discuss their mechanism of action.
  3. Discuss the therapeutic uses, adverse effects and drug interactions of the first-line antiepileptic drugs.
  4. Explain the management of status epilepticus

### **9. Topic: Drugs Used in Parkinson's Disease**

- At the end of this session students should be able to:
  1. Describe the neurotransmitter abnormality in Parkinson's disease
  2. Describe the signs and symptoms of Parkinson's disease.
  3. Classify drugs used in treatment of Parkinson's disease
  4. Explain the mechanism of action and adverse effects of each class of drug

### **10. Topic: Opioid Drugs**

- At the end of this session students should be able to:
  1. Classify opioid drugs based on (i) source (ii) receptor affinity
  2. Discuss the mechanism of action of opioids
  3. Describe the systemic effects of morphine and relate the systemic effects to clinical uses, adverse effects and contraindications to use of morphine
  4. Describe morphine tolerance, dependence and withdrawal effects and treatment of morphine withdrawal. Treatment of morphine addiction.
  5. Describe the sign and symptoms of acute morphine overdose and its management
  6. Compare morphine and mepiridine

### **11. Topic: Alcohol**

- At the end of this session students should be able to:
  1. Describe the mechanism of action of alcohol
  2. Discuss the pharmacokinetics of alcohol with particular emphasis on elimination



3. List the aldehyde dehydrogenase enzyme inhibitors. Name drugs that produce disulfiram-like reaction.
4. Describe the adverse effects of chronic alcoholism
5. Explain the alcohol withdrawal effects and treatment of chronic alcoholism
6. Describe signs symptoms and treatment of methanol poisoning

## **12. Topic: CNS Stimulants**

- At the end of this session students should be able to:
  1. Classify CNS stimulant drugs
  2. Describe the systemic effects and toxicity of CNS stimulant drugs with emphasis on methylxanthines, amphetamines
  3. Discuss the mechanism of action and clinical uses of CNS stimulants.
  4. Describe abuse of CNS stimulants (cocaine, amphetamine)

## **UNIT IV CARDIOVASCULAR SYSTEM**

### **1. Topic: Diuretic Drugs**

- At the end of this session students should be able to:
  1. Classify the five major groups of diuretic drugs and relate them to their site of action
  2. Discuss the mechanism of action, clinical applications and adverse effects of carbonic anhydrase enzyme inhibitors, osmotic diuretics, thiazide diuretics, loop diuretics and potassium sparing diuretics
  3. Tabulate the effect of the major classes of diuretics on serum and urinary electrolyte concentration.

### **2. Topic: Antihypertensive Drugs**

- At the end of this session students should be able to:
  1. Define hypertension and classify hypertension
  2. Briefly explain mechanism for controlling blood pressure through
    - a. *baroreceptors reflexes*
    - b. *renin-angiotensin-aldosterone system*
  3. Classify antihypertensive drugs
  4. Discuss role of diuretics in the management of hypertension
  5. Discuss the role of ACE inhibitors, Angiotensin receptor-blocking agents, Renin inhibitor in hypertension
  6. Explain the rationale for the use of  $\beta$ -blockers,  $\beta$  blockers,  $\alpha$ -adrenoceptor blocking agent, centrally acting sympathoplegic drugs in hypertension
  7. Describe the direct vasodilators (mechanism of action and drug toxicity) in relation to antihypertensive drug therapy
  8. Discuss the pharmacology of Calcium channel blockers
  9. Define hypertensive emergency and discuss the general management and drugs used in the treatment of hypertensive emergencies

### **3. Topic: Drugs used in Angina Pectoris**

- At the end of this session students should be able to:

1. Define angina pectoris
2. Describe the different types of angina pectoris and its brief pathophysiology
3. Classify the drugs used in angina pectoris
4. Explain mechanism of action, pharmacokinetics and adverse effects of organic nitrates and calcium channel blockers
5. Explain the rationale for use of  $\beta$ -adrenergic blockers and sodium channel blocker in the management of angina pectoris

#### **4. Topic: Drugs used in Congestive Heart Failure**

- At the end of this session students should be able to:
- 1. Define cardiac failure, list causes of CHF, enumerate the types of CHF and explain its compensatory physiological responses in heart failure
- 2. Define the different classes of the drug used in the treatment of acute and chronic heart failure
- 3. Describe their mechanism of action, rationale for the use in cardiac failure
- 4. Understand the pharmacological effects, clinical uses, adverse effects and drug interactions of digitalis glycosides
- 5. Explain the signs symptoms and treatment of digoxin overdose
- 6. List positive inotropic drugs (other than digoxin) that are used in heart failure
- 7. Discuss in brief the management of acute congestive heart failure
- 8. Discuss the step-ladder approach in management of various stages of CHF

#### **5. Topic: Antiarrhythmic Drugs**

- At the end of this session students should be able to:
- 1. Classify antiarrhythmic drugs
- 2. Draw the effect of different classes of antiarrhythmic drugs on membrane potential of cardiomyocytes.
- 3. Explain the mechanism of action of all the classes of antiarrhythmic drugs.
- 4. Discuss the adverse effects and clinical uses of antiarrhythmic drugs.

### **UNIT V. DRUGS USED IN DISORDERS OF BLOOD AND INFLAMMATION**

#### **1. Topic: Drugs Used in Thromboembolic Disorders**

- At the end of this session students should be able to:
- 1. List the causes of bleeding disorders
- 2. Discuss the mechanism of action and uses of Vitamin K
- 3. Describe the antifibrinolytic drugs used in bleeding disorders.
- 4. Classify anticoagulant drugs
- 5. Discuss mechanism of action, uses of heparin
- 6. Compare low molecular weight and unfractionated heparin
- 7. Describe adverse effects of heparin and treatment of heparin overdose.
- 8. Describe mechanism of action and uses of direct Xa and IIa inhibitors.
- 9. Describe mechanism of action and uses of warfarin
- 10. Describe adverse effects of warfarin and treatment of warfarin overdose

11. Compare heparin and warfarin
12. Explain monitoring of anticoagulant therapy
13. Describe important drug interactions of warfarin
14. Classify antiplatelet drugs
15. List indications of antiplatelet therapy
16. Explain the mechanism of action and adverse effects of each antiplatelet drug group.
17. Name thrombolytic drugs and explain their mechanism of action, uses and adverse effects

## **2. Topic: Non-steroidal Anti-inflammatory Drugs**

- At the end of this session students should be able to:
  1. Classify NSAIDs
  2. Describe the mechanism of action of NSAIDs
  3. List the clinical uses of NSAIDs
  4. Discuss adverse effects of NSAIDs therapy
  5. Name the contraindications or cautions of NSAIDs use
  6. Explain monitoring of patients on long-term NSAIDs therapy
  7. Describe the potential advantages and disadvantages of COX-2 inhibitors
  8. Describe important drug interactions of NSAIDs/aspirin
  9. Explain therapeutic uses of aspirin and explain the rationale for use in each disorder
  10. Describe the important characteristics of each group of NSAIDs
  11. Compare aspirin and acetaminophen
  12. Discuss acute aspirin overdose and its management
  13. Discuss acute acetaminophen overdose and its management

## **3. Topic: Drugs Used in Dyslipidemias**

- At the end of this session students should be able to:
  1. Briefly describe the types of dyslipidemias
  2. List the hyperlipidemic drug classes
  3. Explain the mechanism of action, effect on serum lipid profile and adverse effects of each of the five drug classes
  4. Name three rational antihyperlipidemic drug combinations

## **UNIT VI DRUGS USED IN RESPIRATORY, GIT DISORDERS**

### **1. Topic: Drugs Used in Bronchial Asthma**

- At the end of this session students should be able to:
  1. Describe the different types of bronchial asthma and its pathogenesis
  2. Classify drugs used in the treatment of acute attack and prophylaxis of bronchial asthma
  3. Explain different classes of bronchodilators and their mechanism of action
  4. Enumerate sympathomimetic agents and their mechanism of action in the treatment of asthma
  5. Describe rationale for use of short acting  $\beta_2$ -adrenergic agonists(SABA) and long acting  $\beta_2$ -adrenergic agonists (LABAS) in the management of asthma
  6. Understand the pharmacological effects, clinical uses, adverse effects of Methyl xanthene

7. Describe use of Anti muscarinic agents in asthma
8. Explain the role Corticosteroids in long-term control of asthma
9. Describe the clinical uses of Cromolyn & Nedocromil – their mechanism of action and adverse effects
10. Explain the pharmacological effects, clinical uses, adverse effects Leukotriene modifiers
11. Define rational for use of Omalizumab

## **2. Topic: Antihistamines**

- At the end of this session students should be able to:
1. Classify antihistamines
  2. Discuss the differences between 1<sup>st</sup> and 2<sup>nd</sup> generation antihistamines
  3. Identify the mechanism of action of antihistamines
  4. Discuss the systemic effects, uses and adverse effects of the 1<sup>st</sup> and 2<sup>nd</sup> generation antihistamines

## **3. Topic: Drugs Used in Peptic Ulcer**

- At the end of this session students should be able to:
1. Discuss in brief the pathophysiology of acid-peptic disorders
  2. Classify drugs used in treatment of peptic ulcer
  3. Discuss the actions of antacids, their adverse effects and drug interactions
  4. Describe the mechanism of action, indications, adverse effects, drug interactions and important pharmacokinetic characteristics of the drug groups used in peptic ulcer
  5. Identify the signs and symptoms of peptic ulcer and explain the triple and quadruple therapeutic regimens for peptic ulcer treatment

## **4. Topic: Antiemetic Drugs**

- At the end of this session students should be able to:
1. Identify the neurotransmitters and receptors involved in pathophysiology of vomiting
  2. Classify antiemetic drugs
  3. Discuss the uses and adverse effects of the different drug groups with reference to their antiemetic effect
  4. Explain the use of antiemetic drugs in (i) motion sickness (ii) hyperemesis gravidarum (iii) chemotherapy-induced vomiting

## **5. Topic: Laxatives, Purgatives and Antidiarrheal Drugs**

- At the end of this session students should be able to:
1. Classify laxative drugs
  2. Discuss the mechanism of action, uses and adverse effects of the bulk forming laxatives, osmotic laxatives and the stool wetting laxative
  3. Describe the stimulant laxatives mechanism of action, uses and adverse effects
  4. Discuss the prokinetic agents. Compare metoclopramide and domperidone
  5. Define enema and suppositories and list some uses with examples
  6. Explain the general principles and approach to treatment of diarrhea
  7. Discuss the use of bulk forming agents, bile acid sequestrants, bismuth and antimotility antisecretory drugs in treatment of diarrhea.

# **UNIT VII CHEMOTHERAPEUTIC DRUGS**

## **1. Topic: Introduction to Chemotherapy**

- At the end of this session students should be able to:
- 1. Explain the meaning of the following terms – antibiotics, disinfectants, antiseptics, selective toxicity, nosocomial infection, community acquired infection, bactericidal drugs, bacteriostatic drugs
- 2. Explain how to determine the efficacy of antimicrobial drugs (MIC, MBC)
- 3. Identify antimicrobial drug targets
- 4. Explain time dependent killing, concentration dependent killing and post-antibiotic effect with examples
- 5. Define empiric therapy, definitive therapy and prophylactic therapy with examples.
- 6. List the reasons for using antimicrobial drug combinations and mechanisms involved in drug synergy.
- 7. Explain mechanisms of antibiotic resistance and how resistance is propagated.

## **2. Topic: Cell Wall Synthesis Inhibitors**

- At the end of this session students should be able to:
- 1. Classify cell wall synthesis inhibitors
- 2. Describe the mechanism of action of beta lactam antibiotics
- 3. Describe the mechanism of resistance to beta lactam antibiotics
- 4. Classify penicillins and describe their antibacterial profile and clinical uses
- 5. Identify the cephalosporin generations and describe their antibacterial spectrum and clinical uses
- 6. List the major adverse effects of penicillins and cephalosporins
- 7. Identify important features of the carbapenems and monobactam
- 8. At the end of this session students should be able to:
- 9. Describe antibacterial spectrum, mechanism of action, resistance, clinical uses and toxicity of vancomycin

## **3. Topic: Protein Synthesis Inhibitors**

- At the end of this session students should be able to:
- 1. Explain briefly the major steps of protein synthesis
- 2. Classify protein synthesis inhibitors
- 3. Enumerate the tetracyclines and discuss mechanism of action, resistance, antibacterial spectrum, clinical uses, adverse effects of tetracyclines
- 4. List pharmacological indication and adverse effects of Glycylcycline
- 5. Classify Macrolide/ Ketolide
- 6. Discuss the mechanism of action and pharmacokinetics, antimicrobial spectrum, clinical uses, adverse effects of Macrolide/ Ketolide
- 7. List mechanism of resistance & drug interactions of Macrolide/ Ketolide
- 8. List the main characteristics of Clindamycin

9. Explain chloramphenicol with respect to its: mechanism of action, resistance, antibacterial spectrum, pharmacokinetics, clinical uses and adverse effects

10. Describe gray baby syndrome

11. List major pharmacokinetic characteristics of Quinupristin/dalfopristin (streptogramins)

#### **4. Topic: Aminoglycosides**

○ At the end of this session students should be able to:

1. Classify Aminoglycosides
2. Describe the mechanism of action, resistance, antibacterial spectrum, pharmacokinetics, clinical uses, adverse effects, contraindications and drug interactions of aminoglycosides
3. Explain concentration-dependent killing, synergistic killing effect and once-daily dosing pattern of Aminoglycosides

#### **5. Topic: Nucleic Acid Inhibitors**

○ At the end of this session students should be able to:

1. Classify nucleic acid inhibitors antibacterial drugs
2. Describe Sulfonamides – classification, antibacterial spectrum, mechanism of action, uses, adverse effects, causes of resistance
3. Describe trimethoprim: mechanism of action and adverse effects
4. Describe co-trimoxazole: composition, mechanism of action, uses and causes of resistance
5. Describe the mechanism of action, of fluoroquinolones and identify mechanisms involved in bacterial resistance to these drugs
6. List the various fluoroquinolones generation and their bactericidal activity and clinical uses
7. Identify the characteristic pharmacokinetic properties and uses of fluoroquinolones

#### **6. Topic: Antimycobacterial Drugs**

○ At the end of this session students should be able to:

1. Briefly describe the signs, symptoms, diagnosis of tuberculosis
2. Classify antituberculous drugs into 1<sup>st</sup> line and 2<sup>nd</sup> line drugs with examples
3. Describe standard protocols (WHO recommendation) for management of newly diagnosed pulmonary tuberculosis, multidrug-resistant tuberculosis, latent tuberculosis
4. Identify characteristic pharmacodynamics and pharmacokinetic properties of rifampin, isoniazid, ethambutol and pyrazinamide
5. Discuss the adverse effects of antituberculous drugs and describe how to monitor patients during antituberculous drug therapy
6. Discuss drugs used in treatment of MDR-TB
7. Describe standard protocols (WHO recommendation) for management of leprosy
8. Identify characteristic pharmacodynamics properties of dapsone and clofazimine and their adverse effects



## **7. Topic: Antifungal Drugs**

- At the end of this session students should be able to:
- 1. Classify of antifungal drugs
- 2. Enumerate drugs used for subcutaneous and systemic mycotic infections
- 3. Discuss mechanisms of action & resistance, pharmacokinetics, clinical uses, adverse effects of Amphotericin B
- 4. Describe mechanism of action, uses and adverse effects of flucytosine.
- 5. Classify Azole antifungal drugs and discuss: mechanism of action, resistance, antifungal spectrum, pharmacokinetics, clinical uses, adverse effects and drug interactions
- 6. Describe important pharmacologic properties of echinocandins.
- 7. List drugs used for cutaneous mycotic infections
- 8. Mechanism of action, resistance, antifungal spectrum, pharmacokinetics, clinical uses, adverse effects of drugs used in cutaneous mycotic infections

## **9. Topic: Antiviral Drugs**

- At the end of this session students should be able to:
- 1. Identify the main steps of viral replication that are targets for antiviral drugs
- 2. Describe in brief infection caused by herpes virus and list the drugs used in treatment of herpes infection and their routes of administration
- 3. Describe the mechanism of action of acyclovir and foscarnet and their adverse effects
- 4. Discuss the standard protocol for treatment of hepatitis B and C
- 5. Describe pharmacodynamics and adverse effects of interferon, entacavir, tenofovir and ribavirin
- 6. Describe the mechanism of action of drugs used in treatment and prophylaxis influenza and their adverse effects
- 7. Draw the life cycle of HIV AIDs virus and identify the antiretroviral drug targets
- 8. Identify significant characteristics of the five groups of drugs used in HIV AIDs
- 9. Describe standard protocols (WHO recommendation) for management of AIDS

## **10. Topic: Drugs Used in Amebiasis**

- At the end of this session students should be able to:
- 1. Classify drugs used in treatment of amebiasis
- 2. Discuss the mechanism of action, uses, adverse effects of metronidazole
- 3. List important features of the luminal amebicides
- 4. List drugs used in hepatic amebiasis and their adverse effects

## **11. Topic: Antimalarial Drugs**

- At the end of this session students should be able to:
- 1. Draw the life cycle of plasmodia
- 2. Classify of Antimalarial Drugs
- 3. Identify mechanism of action and adverse effects of major drug classes

4. Describe the standard protocol for treatment of: P falciparum malaria, Chloroquin resistant P falciparum malaria
5. Name drugs used in: malaria prophylaxis, radical cure of malaria
6. Describe treatment regimen of acute P falciparum malaria

### **12. Topic: Antihelminthic Drugs**

- At the end of this session students should be able to:
  1. Classify anti helminthic drugs
  2. List drugs used for the treatment of nematodes
  3. Explain mechanisms of action, clinical uses, adverse effects of Mebendazole, Pyrantel pamoate, Piperazine, Diethylcarbamazine & Ivermectin
  4. List drugs used for the treatment for Tape worm (cestodes) infection
  5. Explain mechanisms of action, clinical uses, adverse effects of Praziquantel
  6. List drugs used for the treatment of Cestodes infection
  7. Explain mechanisms of action, clinical uses, adverse effects of Niclosamide & Albendazole
  8. Discuss treatment of Neurocystocerciosis

### **13. Topic: Anticancer Drugs**

- At the end of this session students should be able to:
  1. Classify drugs used in cancer chemotherapy with important examples in each group
  2. Compare the cell cycle specific and cell cycle nonspecific drugs
  3. Discuss the log-kill hypothesis and its implication in cancer chemotherapy
  4. Explain the term palliative chemotherapy, neo-adjuvant chemotherapy, adjuvant chemotherapy
  5. List the advantages of multiple drug therapy given in repetitive cycles
  6. Discuss the mechanism of action, uses and adverse effects of the following drug classes – alkylating agents, antimetabolites, antitumor antibiotics, microtubule inhibitors, topoisomerase enzyme inhibitors
  7. Describe in general toxicity of anticancer drugs and describe how to avoid toxicity of – methotrexate, cyclophosphamide, anthracyclines
  8. Discuss the role of hormone in chemotherapy with particular reference to CA prostate and Ca breast.
  9. List use of anticancer drugs in nonmalignant disorders

## **UNIT VIII DRUGS USED IN ENDOCRINE DISORDERS**

### **1. Topic: Thyroid and Antithyroid Drugs**

- At the end of this session students should be able to:
  1. Describe how drugs influence the steps in synthesis and release of thyroid hormones
  2. Discuss signs symptoms of hypothyroidism. Describe the mechanism of action & adverse effects of drugs used in treatment of hypothyroidism
  3. Describe causes, signs and symptoms and Rx of endemic goiter
  4. Describe the signs and symptoms of hyperthyroidism



5. Classify drugs used in hyperthyroidism and discuss their mechanism of action and adverse effects
6. Discuss the Rx of thyroid storm
7. Discuss amiodarone-induced thyroid dysfunction

## **2. Topic: Corticosteroids and Antagonists**

- At the end of this session students should be able to:
  1. Classify corticosteroids and analyze their function
  2. Explain kinetics and dynamics of glucocorticoids and mineralocorticoids
  3. Explain the pharmacologic effects and duration of action of some commonly used natural and synthetic corticosteroids.
  4. Enlist the indications for the use of corticosteroids in adrenal and non-adrenal disorders
  5. Enlist Inhibitors of adrenocorticosteroid biosynthesis or function and describe their mechanism of actions

## **3. Topic: Anti-diabetic Agents**

- At the end of this session students should be able to:
  1. Describe the types of diabetes, diagnosis and complications of diabetes
  2. Discuss the mechanism of insulin release and the effect of insulin on muscle, hepatocytes and adipose tissue
  3. Classify various insulin preparations: classification, onset, peak and duration of action
  4. Explain conventional and Intensive insulin therapy: advantages and disadvantages
  5. Give three example of intensive insulin regimen
  6. Describe the hazards of insulin therapy
  7. Describe the important aspects of other injectable hypoglycemic drugs: Pramlintide and exenatide
  8. Classify oral hypoglycemic drugs
  9. Describe mechanism of action of drugs used in Type2 DM
  10. Describe important pharmacokinetic features and drug interactions of important drugs used in Type 2DM
  11. Explain toxicity of major classes of oral hypoglycemic drugs

## **4. Topic: Gonadal Hormones and Inhibitors**

- At the end of this session students should be able to:
  1. Classify steroids sex gonadal hormones
  2. Explain mechanisms of action, physiologic effects, clinical uses, adverse effects of estrogens
  3. Enlist Selective Estrogen Receptor Modulators, their mechanisms of action, clinical uses, adverse effects, cautions and contraindications
  4. Mention types of progestogens, their mechanisms of action, physiologic effects, clinical uses and adverse effects, cautions and contraindications
  5. Describe major classes of contraceptives and explain their pharmacologic effects, clinical uses, adverse effects contraindications & cautions of oral contraceptives
  6. Describe Estrogen & Progesterone inhibitors & antagonists
  7. Describe metabolism and physiologic effects, clinical uses, adverse effects contraindications & cautions of androgens, anabolic steroids, and anti-androgens

## **UNIT IX DRUGS USED IN BONE AND JOINT DISORDERS**

### **1. Topic: Treatment of Osteoporosis**

- At the end of this session students should be able to:
- 1. Describe the mechanisms contributing to bone mineral homeostasis
- 2. Explain pharmacology of principal and secondary hormonal regulators of bone mineral homeostasis
- 3. Explain Interaction of parathyroid hormone & Vitamin D
- 4. Define osteoporosis and its causes
- 5. Classification of drugs used to treat osteoporosis
- 6. Enlist Bisphosphonates their mechanism of action, pharmacokinetics, adverse effects
- 7. Describe rationale for the use of Selective Estrogen-receptor modulators in management of osteoporosis
- 8. Describe the agents used in the treatment of hypercalcemia and hypocalcemia

### **2. Topic: Drugs Used in Gout**

- At the end of this session students should be able to:
- 1. Describe the pathophysiology, signs and symptoms of gout
- 2. List drugs used in acute attack of gout and chronic gouty arthritis.
- 3. Discuss the mechanism of action, uses and adverse effects of colchicine, allopurinol, febuxostat and probenecid
- 4. Describe the role of NSAIDs and corticosteroids in gout

### **3. Topic: Treatment of Rheumatoid Arthritis**

- At the end of this session students should be able to:
- 1. Discuss in brief the pathophysiology of rheumatoid arthritis
- 2. Classify drugs used in treatment of rheumatoid arthritis
- 3. Discuss the mechanism of action, indications and adverse effects of the DMARDs – chloroquin, azathioprine, methotrexate, cyclophosphamide, leflunomide, cyclosporine
- 4. Discuss the role of monoclonal antibodies – rituximab, adalimumab, infliximab in treatment of rheumatoid arthritis
- 5. Discuss the role of corticosteroids and NSAIDs in rheumatoid arthritis

# **LEARNING OBJECTIVES IN PRACTICAL PHARMACOLOGY**

## **1. Topic: Pharmacy Practical**

○ **At the end of this session students should be able to:**

1. Recognize, demonstrate and explain the uses of instruments commonly employed in pharmacy experiments.
2. Explain the imperial and metric systems of weights and measures and know how to interconvert the measures.
3. List the different dosage forms of drugs
4. Properly label, wrap, seal and dispense drugs in powder form and liquid form
5. Calculate strengths of solution expressed as percent weight or volume
6. Explain different types of solutions
7. Prepare and dispense normal saline solution, dextrose saline solution and ORS and explain their uses
8. Explain the components and types of mixtures
9. Prepare and dispense carminative mixture and list its uses
10. Calculate and prepare  $\text{KMnO}_4$  stock solution. Prepare and dispense different dilutions of  $\text{KMnO}_4$  using stock solution. List the uses of  $\text{KMnO}_4$  solution.
11. Explain the different types of ointment and its uses
12. Prepare and dispense sulphur ointment and give proper directions for its use in scabies.
13. Explain different types of powders. Prepare and dispense APC powder.

## **2. Topic: Prescription writing**

○ **At the end of the session students should be able to:**

1. Explain the various parts of a prescription
2. Recognize and explain abbreviations used in prescription writing
3. Calculate pediatric dose, loading dose, maintenance dose, half-life, bioavailability by using formulae.
4. Using the P-drug concept, be able to write prescriptions for – amebic dysentery, bacillary dysentery, typhoid, ascariasis, malaria, tuberculosis, bacterial pneumonia, asthma, hypertension, angina pectoris, congestive heart failure, epilepsy (grand mal, petit mal), peptic ulcer, GERD.

## **4. Topic: Biostatistics**

○ **At the end of the session students should be able to:**

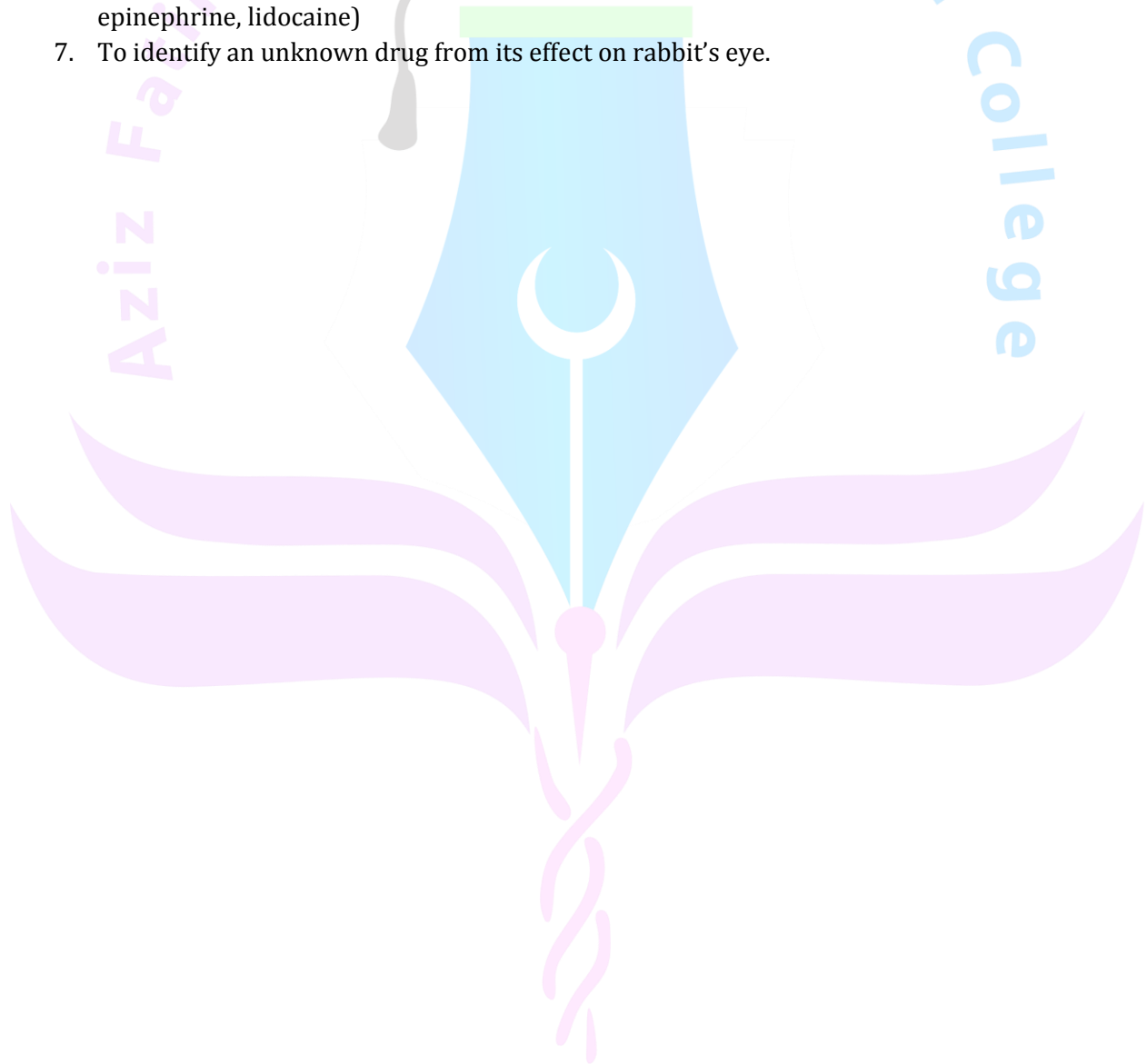
1. Calculate mean, median, mode, standard error, standard deviation from a given set of data

## **5. Topic: Experimental Pharmacology**

○ **At the end of the session students should be able to:**

1. Explain the instruments used in isolated organ experiments – organ bath, kymograph

2. Describe the conditions required for performing in-vitro pharmacological experiments, the purpose of using physiological solutions, its composition and role of various components.
3. Demonstrate the effect of acetylcholine on isolated rabbit's ileum and make a dose-response curve of acetylcholine
4. Using the isolated rabbit's ileum, demonstrate and explain the effect of atropine on contractions produced by acetylcholine.
5. Demonstrate the effect of acetylcholine on isolated rectus abdominis muscle of frog and make a dose response curve of acetylchoine. To demonstrate the effect of atracurium on acetylcholine –induced contraction of the rectus muscle.
6. Demonstrate and explain the effect of drugs on rabbit's eye. (pilocarpine, atropine, epinephrine, lidocaine)
7. To identify an unknown drug from its effect on rabbit's eye.



### **RECOMMENDED TEXTBOOKS**

- Basic and Clinical Pharmacology by Bertram G Katzung, 13<sup>th</sup> Edition
- Katzung and Trevor Pharmacology, Examination and Board Review, 11<sup>th</sup> Edition
- Lippincott Illustrated Pharmacology, Richard A Harvey Karen Whalen, 6<sup>th</sup> Edition

### **Recommended Reference Book**

- Rang and Dale's Pharmacology, 8<sup>th</sup> Edition

### **SUGGESTED ON-LINE RESOURCES**

- [www.cvpharmacology.com](http://www.cvpharmacology.com)
- [www.pharmacology2000.com](http://www.pharmacology2000.com)
- [www.msdmanuals.com/professional](http://www.msdmanuals.com/professional)
- [www.medscape.com](http://www.medscape.com)

