

# LESSON PLAN

## PHARMACEUTICAL CHEMISTRY – THEORY

**Course Code: ER20-12T**

**75 Hours (3 Hours/week)**

**Name of Tutor/Teacher: Sh. Shiv Kumar, Lecturer in Pharmacy**

**Schedule of Classes: Theory:** Tuesday: 09.00 – 10.00 AM, Wednesday: 09.00 – 10.00 AM,  
Thursday: 09.00 – 10.00 AM

**Scope:** This course is designed to impart basic knowledge on the chemical structure, storage conditions and medicinal uses of organic and inorganic chemical substances used as drugs and pharmaceuticals. Also, this course discusses the impurities, quality control aspects of chemical substances used in pharmaceuticals.

**Course Objectives:** This course will discuss the following aspects of the chemical substances used as drugs and pharmaceuticals for various disease conditions

1. Chemical classification, chemical name, chemical structure
2. Pharmacological uses, doses, stability and storage conditions
3. Different types of formulations / dosage form available and their brand names
4. Impurity testing and basic quality control tests

**Course Outcomes:** Upon successful completion of this course, the students will be able to

**CO1.2T.1.** Describe the chemical class, structure and chemical name of the commonly used drugs and pharmaceuticals of both organic and inorganic nature

**CO1.2T.2.** Discuss the pharmacological uses, dosage regimen, stability issues and storage conditions of all such chemical substances commonly used as drugs

**CO1.2T.3.** Describe the quantitative and qualitative analysis, impurity testing of the chemical substances given in the official monographs

**CO1.2T.4.** Identify the dosage form & the brand names of the drugs and pharmaceuticals popular in the marketplace

Chapter	Topic	Date	Hour	CO	PO	Coverage	Reason for discrepancy	Plans for compensation in backlog	Taught by	Verified by
1	<b>Introduction to Pharmaceutical Chemistry:</b> Scope and objectives		1							
	<b>Sources and types of errors:</b> Accuracy, precision, significant figures		2							
	<b>Impurities in Pharmaceuticals:</b> Source and effect of impurities in Pharmacopoeial substances		3							
	<b>Importance of limit test</b>		4							
	<b>Principle and procedures of Limit tests</b> for chlorides and sulphates		5							
	<b>Principle and procedures of Limit tests</b> for iron and arsenic		6							
	<b>Principle and procedures of Limit tests</b> for heavy metals		7							
	<b>Principle and procedures of Limit tests</b> for heavy metals		8							
2	<b>Volumetric analysis:</b> Fundamentals of volumetric analysis		1							
	Acid-base titration		2							
	Acid-base titration		3							
	Non-aqueous titration		4							
	Precipitation titration		5							
	Complexometric titration		6							
	Redox titration		7							
	Gravimetric analysis: Principle and method.		8							
3	<b>Inorganic Pharmaceuticals: Pharmaceutical formulations, market preparations, storage conditions and uses of Haematinics:</b> Ferrous sulphate, Ferrous fumarate, Ferric ammonium citrate, Ferrous ascorbate, Carbonyl iron		1							
	<b>Gastro-intestinal Agents:</b> <b>Antacids:</b> Aluminium hydroxide gel, Magnesium hydroxide, Magaldrate, Sodium bicarbonate, Calcium Carbonate,		2							

	Acidifying agents, Adsorbents, Protectives, Cathartics		3						
	<b>Topical agents:</b> Silver Nitrate, Ionic Silver, Chlorhexidine Gluconate, Hydrogen peroxide		4						
	Boric acid, Bleaching powder, Potassium permanganate		5						
	<b>Dental products:</b> Calcium carbonate, Sodium fluoride, Denture cleaners, Denture adhesives, Mouth washes		6						
	<b>Medicinal gases:</b> Carbon dioxide, nitrous oxide, oxygen		7						
4	Introduction to nomenclature of organic chemical systems with		1						
	Introduction to nomenclature of heterocyclic compounds containing up to Three rings		2						
	<b><i>Study of the following category of medicinal compounds with respect to classification, chemical name, chemical structure (compounds marked with*) uses, stability and storage conditions, different types of formulations and their popular brand names</i></b>								
5	<b>Drugs Acting on Central Nervous System</b>		1						
	<b>Anaesthetics:</b> Thiopental Sodium*, Ketamine Hydrochloride*, Propofol		2						
	<b>Sedatives and Hypnotics:</b> Diazepam*, Alprazolam*, Nitrazepam, Phenobarbital*		3						
	<b>Antipsychotics:</b> Chlorpromazine Hydrochloride*, Haloperidol*, Risperidone*		4						
	<b>Antipsychotics:</b> Sulpiride*, Olanzapine, Quetiapine, Lurasidone		5						
	<b>Anticonvulsants:</b> Phenytoin*, Carbamazepine*, Clonazepam, Valproic Acid*		6						
	<b>Anticonvulsants:</b> Gabapentin*, Topiramate, Vigabatrin, Lamotrigine		7						
	<b>Anti-Depressants:</b> Amitriptyline Hydrochloride*, Imipramine Hydrochloride*, Fluoxetine*,		8						
	<b>Anti-Depressants:</b> Venlafaxine, Duloxetine, Sertraline, Citalopram, Escitalopram, Fluvoxamine, Paroxetine		9						
6	<b>Drugs Acting on Autonomic Nervous System</b>		1						
	<b>Sympathomimetic Agents:</b> <b>Direct Acting:</b> Nor-Epinephrine*, Epinephrine, Phenylephrine, Dopamine*, Terbutaline, Salbutamol (Albuterol), Naphazoline*, Tetrahydrozoline.		2						
	<b>Indirect Acting Agents:</b> Hydroxy Amphetamine, Pseudoephedrine.		3						

	<b>Agents With Mixed Mechanism:</b> Ephedrine, Metaraminol								
	<b>Adrenergic Antagonists:</b> <b>Alpha Adrenergic Blockers:</b> Tolazoline, Phentolamine, Phenoxybenzamine, Prazosin.	4							
	<b>Beta Adrenergic Blockers:</b> Propranolol*, Atenolol*, Carvedilol	5							
	<b>Cholinergic Drugs and Related Agents:</b> <b>Direct Acting Agents:</b> Acetylcholine*, Carbachol, Pilocarpine.	6							
	<b>Cholinesterase Inhibitors:</b> Neostigmine*, Edrophonium Chloride, Tacrine Hydrochloride, Pralidoxime Chloride, Echothiopate Iodide	7							
	<b>Cholinergic Blocking Agents:</b> Atropine Sulphate*, Ipratropium Bromide	8							
	<b>Synthetic Cholinergic Blocking Agents:</b> Tropicamide, Cyclopentolate Hydrochloride, Clidinium Bromide, Dicyclomine Hydrochloride*	9							
7	<b>Drugs Acting on Cardiovascular System</b> <b>Anti-Arrhythmic Drugs:</b> Quinidine Sulphate, Procainamide Hydrochloride, Verapamil, Phenytoin Sodium*	1							
	<b>Anti-Arrhythmic Drugs:</b> Lidocaine Hydrochloride, Lorcaïnide Hydrochloride, Amiodarone and Sotalol	2							
	<b>Anti-Hypertensive Agents:</b> Propranolol*, Captopril*, Ramipril, Methyldopate Hydrochloride,	3							
	<b>Anti-Hypertensive Agents:</b> Clonidine Hydrochloride, Hydralazine Hydrochloride, Nifedipine	4							
	<b>Antianginal Agents:</b> Isosorbide Dinitrate	5							
8	<b>Diuretics:</b> Acetazolamide, Frusemide*, Bumetanide, Chlorthalidone, Benzthiazide	1							
	<b>Diuretics:</b> Metolazone, Xipamide, Spironolactone	2							
9	<b>Hypoglycemic Agents:</b> Insulin and Its Preparations,	1							
	<b>Hypoglycemic Agents:</b> Metformin*, Glibenclamide*, Glimepiride	2							
	<b>Hypoglycemic Agents:</b> Pioglitazone, Repaglinide, Gliflozins, Gliptins	3							
10	<b>Analgesic And Anti-Inflammatory Agents:</b> Morphine Analogues, Narcotic Antagonists;	1							
	<b>Nonsteroidal Anti-Inflammatory Agents (NSAIDs) -</b> Aspirin*, Diclofenac, Ibuprofen*, Piroxicam,	2							

	<b>Nonsteroidal Anti-Inflammatory Agents (NSAIDs)</b> - Celecoxib, Mefenamic Acid, Paracetamol*, Aceclofenac		3						
11	<b>Anti-Infective Agents</b>		1						
	<b>Antifungal Agents:</b> Amphotericin-B, Griseofulvin, Miconazole, Ketoconazole*, Itraconazole, Fluconazole*, Naftifine Hydrochloride		2						
	<b>Urinary Tract Anti-Infective Agents:</b> Norfloxacin, Ciprofloxacin, Ofloxacin*, Moxifloxacin,		3						
	<b>Anti-Tubercular Agents:</b> INH*, Ethambutol, Para Amino Salicylic Acid,		4						
	<b>Anti-Tubercular Agents:</b> Pyrazinamide, Rifampicin, Bedaquiline, Delamanid, Pretomanid*		5						
	<b>Antiviral Agents:</b> Amantadine Hydrochloride, Idoxuridine, Acyclovir*, Foscarnet, Zidovudine, Ribavirin, Remdesivir, Favipiravir		6						
	<b>Antimalarials:</b> Quinine Sulphate, Chloroquine Phosphate*, Primaquine Phosphate, Mefloquine*, Cycloguanil, Pyrimethamine, Artemisinin		7						
	<b>Sulfonamides:</b> Sulfanilamide, Sulfadiazine, Sulfamethoxazole, Sulfacetamide*, Mafenide Acetate, Cotrimoxazole, Dapsone*		8						
12	<b>Antibiotics:</b>		1						
	<b>Antibiotics:</b> Penicillin G, Amoxicillin*		2						
	Cloxacillin, Streptomycin		3						
	<b>Tetracyclines:</b> Doxycycline, Minocycline,		4						
	<b>Macrolides:</b> Erythromycin, Azithromycin,		5						
	<b>Miscellaneous:</b> Chloramphenicol*, Clindamycin		6						
	<b>Miscellaneous:</b>		7						
	<b>Miscellaneous:</b>		8						
13	<b>Anti-Neoplastic Agents:</b> Cyclophosphamide*, Busulfan, Mercaptopurine, Fluorouracil		1						
	<b>Anti-Neoplastic Agents:</b> Methotrexate, Dactinomycin, Doxorubicin Hydrochloride, Vinblastine Sulphate,		2						
	<b>Anti-Neoplastic Agents:</b> Cisplatin*, Dromostanolone Propionate		3						

# PHARMACEUTICAL CHEMISTRY – PRACTICAL

**Course Code: ER20-12P**

**75 Hours (3 Hours/week)**

**Name of Tutor/Teacher: Sh. Shiv Kumar, Lecturer in Pharmacy**

**Schedule of Classes:**

**Practical: *Batch A*: Tuesday**

**Practical: *Batch B*: Friday**

**Practical: *Batch C*: Thursday**

**Scope:** This course is designed to impart basic training and hands-on experiences to synthesis chemical substances used as drugs and pharmaceuticals. Also, to perform the quality control tests, impurity testing, test for purity and systematic qualitative analysis of chemical substances used as drugs and pharmaceuticals.

**Course Objectives:** This course will provide the hands-on experience on the following aspects of chemical substances used as drugs and pharmaceuticals

1. Limit tests and assays of selected chemical substances as per the monograph
2. Volumetric analysis of the chemical substances
3. Basics of preparatory chemistry and their analysis
4. Systematic qualitative analysis for the identification of the chemical drugs

**Course Outcomes:** Upon successful completion of this course, the students will be able to

**CO1.2P.1.** Perform the limit tests for various inorganic elements and report

**CO1.2P.2.** Prepare standard solutions using the principles of volumetric analysis

**CO1.2P.3.** Test the purity of the selected inorganic and organic compounds against the monograph standards

**CO1.2P.4.** Synthesize the selected chemical substances as per the standard synthetic scheme

**CO1.2P.5.** Perform qualitative tests to systematically identify the unknown chemical substances

Exp. No.	Experiment	Batch	Date	CO	PO	Coverage	Reason for discrepancy	Plans for compensation in backlog	Taught by	Verified by
1	Limit test for Chlorides, sulphates, Iron	A								
		B								
		C								
2	Limit test for heavy metals	A								
		B								
		C								
3	Identification tests for Anions as per Indian Pharmacopoeia	A								
		B								
		C								
4	Identification tests for Anions as per Indian Pharmacopoeia	A								
		B								
		C								
5	Identification tests for Cations as per Indian Pharmacopoeia	A								
		B								
		C								
6	Identification tests for Cations as per Indian Pharmacopoeia	A								
		B								
		C								
7	<b>Fundamentals of Volumetric analysis</b> Preparation of standard solution and standardization of Sodium Hydroxide	A								
		B								
		C								
8	<b>Fundamentals of Volumetric analysis</b> Preparation of standard solution and standardization of Potassium Permanganate	A								
		B								
		C								
9	<b>Assay of the following compounds</b> Ferrous sulphate- by redox titration	A								
		B								
		C								
10	<b>Assay of the following compounds</b> Calcium gluconate-by complexometric	A								
		B								
		C								
11	<b>Assay of the following compounds</b> Sodium chloride-by Modified Volhard's method	A								
		B								
		C								
12	<b>Assay of the following compounds</b> Ascorbic acid by iodometry	A								
		B								
		C								

13	<b>Assay of the following compounds</b> Ibuprofen by alkalimetry	A								
		B								
		C								
14	<b>Fundamentals of preparative organic chemistry</b> Determination of Melting point of organic compounds	A								
		B								
		C								
15	Determination of boiling point of organic compounds	A								
		B								
		C								
16	Preparation of organic compounds Benzoic acid from Benzamide	A								
		B								
		C								
17	Preparation of organic compounds Picric acid from Phenol	A								
		B								
		C								
18	Identification and test for purity of pharmaceuticals Aspirin,	A								
		B								
		C								
19	Identification and test for purity of pharmaceuticals Caffeine	A								
		B								
		C								
10	Identification and test for purity of pharmaceuticals Paracetamol	A								
		B								
		C								
21	Identification and test for purity of pharmaceuticals Sulfanilamide	A								
		B								
		C								
22	Systematic Qualitative analysis experiments (4 substances) <b>First Substance</b>	A								
		B								
		C								
23	Systematic Qualitative analysis experiments (4 substances) <b>Second Substance</b>	A								
		B								
		C								
24	Systematic Qualitative analysis experiments (4 substances) <b>Third Substance</b>	A								
		B								
		C								
25	Systematic Qualitative analysis experiments (4 substances) <b>Fourth Substance</b>	A								
		B								
		C								



## ASSIGNMENTS

The students shall be asked to submit the written assignments on the following topics (One assignment per student per sessional period. i.e., a minimum of THREE assignments per student)

1. Different monographs and formularies available and their major contents
2. Significance of quality control and quality assurance in pharmaceutical industries
3. Overview on Green Chemistry
4. Various software programs available for computer aided drug discovery
5. Various instrumentations used for characterization and quantification of drug

## SUGGESTED READINGS

1. Medicinal & Pharmaceutical chemistry by Harikishan Singh and VK Kapoor
2. Wilson and Griswold's Text book of Organic Medicinal and pharmaceutical Chemistry
3. Practical Organic Chemistry by Mann and Saunders.
4. Practical Pharmaceutical Chemistry, Volume- I & II by Beckett and J. B. Stenlake
5. Indian Pharmacopoeia
6. Vogel's text book of Practical Organic Chemistry

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