Name of Faculty	:	Faculty of Pharmacy
Name of Program	:	Diploma in Pharmacy
Course Code	:	1DPH04
Course Title	:	Pharmaceutical Chemistry
Type of Course	:	Basic Pharmaceutical Sciences
Year of Introduction	:	2023-24

Prerequisite	:	Zeal to learn the subject
Course Objective	:	Thiscourseisdesignedtoimpartbasicknowledgeonthechemicalstructure, 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. 1. Chemical classification, chemical name, chemical structure 2. Pharmacological uses, doses, stability and storage conditions 3. Different types of formulations / dos age form available and their brand names 4. Impurity testing and basic quality control tests 5. Limit tests and assays of selected chemical substances as per the monograph 6. Volumetric analysis of the chemical substances 7. Basics of preparatory chemistry and their analysis 8. Systematic qualitative analysis for the identification of the chemical drugs
Course Outcomes	:	At the end of this course, students will be able to:
	CO1	Describe after understanding the chemical class, structure and chemical name of the commonly used drugs and pharmaceuticals of both organic and inorganic nature
	CO2	Understand the pharmacological uses, dosage regimen, stability issues and storage conditions of all such chemical substances commonly used as drugs
	CO3	Apply the result of the quantitative and qualitative analysis, impurity testing of the chemical substances given in the official monographs into the required spread sheet.

	CO4	Identify and evaluate the dosage form & the brand names of the drugs and pharmaceuticals popular in the marketplace
	C05	Perform the limit tests for various inorganic elements and report
	C06	Prepare standard solutions using the principles of volumetric analysis
	C07	Test the purity of the selected inorganic and organic compounds against the monograph standards
	C08	Synthesize the selected chemical substances as per the standard synthetic scheme
	C09	Perform qualitative tests to systematically identify the unknown chemical substances

Teaching and Examination Scheme

Teaching Scheme (Contact Hours)			Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	SEE	CIA	SEE	CIA	
03	01	03	06	80	20	80	20	200

*Legends: **L**-Lecture; **T**–Tutorial/Teacher Guided Theory Practice; **P** – Practical, **C** – Credit, **SEE** – Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

Unit No.	Topics	Teaching Hours	Weightage	Mapping With COs
1	**Introduction to Pharmaceutical chemistry:** Scope and objectives **Sources and types of errors:** Accuracy, precision, significant figures **Impurities in Pharmaceuticals:** Source and effect of impurities in Pharmacopeial substances, importance of limit test, Principle and procedures of Limit tests forchlorides, sulphates, iron, heavy metals and arsenic.	**08**	**10.66%**	**CO1** **CO5**
2	**Volumetric analysis:** Fundamentals of volumetric analysis, Acid-base titration, non-aqueous titration, precipitation titration,	**08**	**10.66%**	**CO6**

	complexometric titration, redox titration **Gravimetric analysis:** Principle and method.			
3	**Inorganic Pharmaceuticals:** Pharmaceutical formulations, market preparations, storage conditions and uses of • **Haematinics**: Ferrous sulphate, Ferrous fumarate, Ferric ammonium citrate, Ferrous ascorbate, Carbonyl iron • **Gastro-intestinal Agents:** Antacids: Aluminium hydroxide gel, Magnesium hydroxide, Magaldrate, Sodium bicarbonate, Calcium Carbonate, Acidifying agents, Adsorbents, Protectives, Cathartics • **Topical agents:** Silver Nitrate, Ionic Silver, Chlorhexidine Gluconate, Hydrogen peroxide, Boric acid, Bleaching powder, Potassium permanganate • **Dental products**: Calcium carbonate, Sodium fluoride, Denture cleaners, Denture adhesives, Mouth washes • **Medicinal gases:** Carbon dioxide, nitrous oxide, oxygen	**07**	**9.33%**	**CO4**
4	Introduction to nomenclature of organic chemical systems with particular reference to hetero cyclic compounds containing up to Three rings	**02**	**2.66%**	**CO1**
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				
5	**Drugs Acting on Central Nervous System** • **Anaesthetics:** Thiopental Sodium*, Ketamine Hydrochloride*, Propofol • **Sedatives and Hypnotics:** Diazepam*, Alprazolam*, Nitrazepam, Phenobarbital* • **Antipsychotics:** Chlorpromazine Hydrochloride*, Haloperidol*, Risperidone*, Sulpiride*, Olanzapine,	**09**	**12%**	**CO3** **CO4** **CO7**

	Quetiapine, Lurasidone • **Anticonvulsants:** Phenytoin*, Carbamazepine*, Clonazepam, Valproic Acid*, Gabapentin*, Topiramate, Vigabatrin, Lamotrigine • **Anti-Depressants:** Amitriptyline Hydrochloride*, Imipramine Hydrochloride*, Fluoxetine*, Venlafaxine, Duloxetine, Sertraline, Citalopram, Escitalopram,Fluvoxamine, Paroxetine			
6	**Drugs Acting on Autonomic Nervous System SympathomimeticAgents:** **Direct Acting:** Nor- Epinephrine*, Epinephrine, Phenylephrine Dopamine*, Terbutaline, Salbutamol (Albuterol), Naphazoline*, Tetrahydrozoline. Indirect Acting Agents: Hydroxy Amphetamine, Pseudoephedrine. Agents With Mixed Mechanism: Ephedrine, Metaraminol • **Adrenergic Antagonists:** Alpha Adrenergic Blockers: Tolazoline, Phentolamine • Phenoxybenzamine, Prazosin. Beta Adrenergic Blockers: Propranolol*, Atenolol*, Carvedilol • **Cholinergic Drugs and Related Agents:** Direct Acting Agents: Acetylcholine*, Carbachol, And Pilocarpine. Cholinesterase Inhibitors: Neostigmine*, Edrophonium Chloride, Tacrine Hydrochloride, Pralidoxime Chloride, Echothiopate Iodide • **Cholinergic Blocking Agents:** Atropine Sulphate*, Ipratropium Bromide Synthetic Cholinergic Blocking Agents: Tropicamide, Cyclopentolate Hydrochloride, Clidinium	**09**	**12%**	**CO5** **CO7**

	Bromide, Dicyclomine Hydrochloride*			
7	**Drugs Acting on Cardiovascular System** ● **Anti-Arrhythmic Drugs:** Quinidine Sulphate, Procainamide Hydrochloride, Verapamil, Phenytoin Sodium*, Lidocaine Hydrochloride, Lorcainide Hydrochloride, Amiodarone and Sotalol ● **Anti-Hypertensive Agents**: Propranolol*, Captopril*, Ramipril, Methyldopate Hydrochloride, Clonidine Hydrochloride, Hydralazine Hydrochloride, Nifedipine, **Antianginal Agents:** Isosorbide Dinitrate	**05**	**6.66%**	**CO4** **CO8** **CO9**
8	**Diuretics:** Acetazolamide, Frusemide*, Spironolactone	**02**	**2.66%**	**CO1**
9	**Hypoglycemic Agents: Insulin and Its Preparations,** Metformin*, Glibenclamide*, Repaglinide, Gliflozins, Gliptins	**03**	**4%**	**CO1**
10	**Analgesic And Anti-Inflammatory Agents:** Morphine Analogues, Narcotic Antagonists; Nonsteroidal Anti- Inflammatory Agents (NSAIDs) - Aspirin*, Diclofenac, Ibuprofen*, Piroxicam, Celecoxib, Mefenamic Acid, Paracetamol*, Aceclofenac	**03**	**4%**	**CO1** **CO4**
11	**Anti-Infective Agents** ● Antifungal Agents:Amphotericin-B,Griseofulvin, Miconazole, Ketoconazole*, Itraconazole, Fluconazole*, Naftifine Hydrochloride ● **Urinary Tract Anti-Infective Agents**: Norfloxacin, Ciprofloxacin, Ofloxacin*, Moxifloxacin, ● **Anti-Tubercular Agents:** INH*, Ethambutol, Para Amino Salicylic Acid, Pyrazinamide, Rifampicin, Bedaquiline, Delamanid, Pretomanid* ● **Antiviral Agents:** Amantadine	**08**	**10.66%**	**CO1** **CO3** **CO6**

	Hydrochloride, Idoxuridine, Acyclovir*, Foscarnet, Zidovudine, Ribavirin, Remdesivir, Favipiravir • **Antimalarials:** Quinine Sulphate, Chloroquine Phosphate*, Primaquine Phosphate, Mefloquine*, Cycloguanil, Pyrimethamine, Artemisinin • **Sulfonamides:** Sulfanilamide, Sulfadiazine, Sulfamethoxazole, Sulfacetamide*, Mafenide Acetate, Cotrimoxazole, Dapsone*			
12	**Antibiotics:** Penicillin G, Amoxicillin*, Cloxacillin, Streptomycin, Tetracyclines: Doxycycline, Minocycline, Macrolides: Erythromycin, Azithromycin, Miscellaneous: Chloramphenicol* Clindamycin	**08**	**10.66%**	**CO2** **CO4** **CO6**
13	Anti-Neoplastic Agents: Cyclophosphamide*, Busulfan, Mercaptopurine, Fluorouracil*, Methotrexate, Dactinomycin, Doxorubicin Hydrochloride, Vinblastine Sulphate, Cisplatin*, Dromostanolone Propionate	**03**	**4%**	**CO4** **CO6**

Suggested List of Experiments

Sr. No.	Experiment	Teaching Hours
1	Limit test for Chlorides; sulphate; Iron; heavy metals	12
2	Identification tests for Anions and Cations as per Indian Pharmacopoeia	03
3	Fundamentals of Volumetric analysis Preparation of standard solution and standardization of Sodium Hydroxide, Potassium Permanganate	09
4	Assay of the following compounds Ferrous sulphate- by redox titration Calcium gluconate-by complexometric Sodium chloride-by Modified Volhard's method Ascorbic acid by iodometry Ibuprofen by alkalimetry	15
5	Fundamentals of preparative organic chemistry Determination of Melting point and boiling point of organic compounds	09
6	Preparation of organic compounds Benzoic acid from Benzamide	06

	Picric acid from Phenol	
7	Identification and test for purity of pharmaceuticals Aspirin, Caffeine, Paracetamol, Sulfanilamide	09
8	Systematic Qualitative analysis experiments (4 substances)	12

Suggested List of Assignments

Sr. No.	Assignment	Teaching Hours
1	Different monographs and formularies available and their major contents	03
2	Significance of quality control and quality assurance in pharmaceutical industries	03
3	Overview on Green Chemistry	03
4	Various software programs available for computer aided drug discovery	03
5	Various instrumentations used for characterization and quantification of drug	03

Field Visit

Sr. No.	Field Visit	Duration (Hours)
1	The students shall be taken for an industrial visit to pharmaceutical industries to witness and understand the various processes of manufacturing of any of the common dosage forms viz. tablets, capsules, liquid orals, injectables, etc. Individual reports from each student on their learning experience from the field visit shall be submitted.	**03**

Suggested Distribution of Theory Marks Using Bloom's Taxonomy						
Level	Remembrance	Understanding	Application	Analyse	Evaluate	Create
Weightage	-	22.2	33.3	-	33.3	11.2

Major Equipment/Instruments and Software Required

Sr. No.	Name of Major Equipment/ Instruments and Software
1	Hot plates
2	Hot Air Oven

3	Refrigerator
4	Analytical Balances for demonstration
5	Digital balance 10mg sensitivity
6	Magnetic Stirrers with Thermostat
7	Vacuum Pump
8	Digital pH meter
9	Wall Mounted Water Distillation Unit
10	Nessler's Cylinders
11	Digital Melting Point Apparatus
12	Thieles Tube
13	Digital Colorimeter
14	Thermostatic WaterBath

Suggested Learning Websites

Sr. No.	Name of Website
1	https://pci.nic.in/pdf/Syllabus_B_Pharm.pdf
2	https://www.aicte-india.org/downloads/bpharma.pdf.
3	https://www.ipc.gov.in/
4	https://www.ayush.gov.in/
5	https://ayudmla.gujarat.gov.in/home.php
6	https://www.fda.gov/
7	https://www.pharmacopoeia.com/
8	https://ipapharma.org/
9	https://gpat.nta.nic.in/
10	https://drnaitiktrivedi.com/
11	https://gdc4gpat.com/course/gpat/
12	https://niscpr.res.in/
13	https://delnet.in/
14	https://ihubgujarat.in/
15	https://www.ssipgujarat.in/

Reference Books

Sr. No.	Name of Reference Books
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