



4-Year Bachelor of Pharmacy (B.Pharm) Curriculum and Syllabus
Course Structure
Fifth Semester

Course Code	Name of the course	No.of hours	Tutorial	Credit points
TIU-UBP-501T	Medicinal Chemistry II–Theory	3	1	4
TIU-UBP-502T	Industrial Pharmacy I –Theory	3	1	4
TIU-UBP-503T	Pharmacology II–Theory	3	1	4
TIU-UBP-504T	Pharmacognosy and Phytochemistry II– Theory	3	1	4
TIU-UBP-505T	Pharmaceutical Jurisprudence –Theory	3	1	4
TIU-UBP-506P	Industrial Pharmacy I– Practical	4	-	2
TIU-UBP-507P	Pharmacology II– Practical	4	-	2
TIU-UBP-508P	Pharmacognosy and Phytochemistry II– Practical	4	-	2
	Total	27	5	26



B.PHARM SYLLABUS

SEMESTER-V

Medicinal Chemistry II- Theory (TIU-UBP-501T)

Contact hours: 45 hrs

Course Objectives

Upon completion of the course the student shall be able to:

1. Understand the chemistry of drugs with respect to their pharmacological activity
2. Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
3. Know the Structural Activity Relationship of different class of drugs
4. Study the chemical synthesis of selected drugs

Course Outcomes

Upon completion of the course, the student shall be able

CO1. **Classify** different drugs according to their chemical and pharmacological outcome

CO2. **Identify** major important drug of various class and subclass and their pharmaceutically important features.

CO3. **Summarize** the structure activity relationship and route of synthesis of various drugs.

CO4. **Compare** different generation of drugs and their chemical and pharmacological advances

Course Content

45 Hours

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)

UNIT- I

10 Hours

Antihistaminic agents: Histamine, receptors and their distribution in the human body

H1-antagonists: Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamine succinate, Clemastine fumarate, Diphenylpyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartrate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetazine Cromolyn sodium

H2-antagonists: Cimetidine*, Famotidine, Ranitidine.

Gastric Proton pump inhibitors: Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole



Anti-neoplastic agents:

Alkylating agents: Meclorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa

Antimetabolites: Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine

Antibiotics: Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin

Plant products: Etoposide, Vinblastin sulphate, Vincristin sulphate

Miscellaneous: Cisplatin, Mitotane.

UNIT – II

10 Hours

Anti-anginal:

Vasodilators: Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbidedinitrite*, Dipyridamole.

Calcium channel blockers: Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.

Diuretics:

Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide.

Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide,

Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid.

Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride.

Osmotic Diuretics: Mannitol

Anti-hypertensive Agents: Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride, *Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.

UNIT- III

10 Hours

Anti-arrhythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcaïnide hydrochloride, Amiodarone, Sotalol.

Anti-hyperlipidemic agents: Clofibrate, Lovastatin, Cholesteramine and Cholestipol

Coagulant & Anticoagulants: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel

Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.

UNIT- IV

08 Hours

Drugs acting on Endocrine system

Nomenclature, Stereochemistry and metabolism of steroids

Sex hormones: Testosterone, Nandralone, Progesterones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol.

Drugs for erectile dysfunction: Sildenafil, Tadalafil.



Oral contraceptives: Mifepristone, Norgestrel, Levonorgestrol

Corticosteroids: Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone

Thyroid and antithyroid drugs: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.

UNIT – V

07 Hours

Antidiabetic agents:

Insulin and its preparations

Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride.

Biguanides: Metformin.

Thiazolidinediones: Pioglitazone, Rosiglitazone.

Meglitinides: Repaglinide, Nateglinide.

Glucosidase inhibitors: Acarbose, Voglibose.

Local Anesthetics: SAR of Local anesthetics

Benzoic Acid derivatives; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine.

Amino Benzoic acid derivatives: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate.

Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine.

Miscellaneous: Phenacaine, Dipiperodon, Dibucaine.*

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1 to 5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I. Vogel.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Classify different drugs according to their chemical and pharmacological outcome	PO1, PO2, PO4, PEO1, PEO2, PEO3
CO2	Identify major important drug of various class and subclass and their pharmaceutically important features.	PO1, PO3, PO5, PEO1, PEO2, PEO3
CO3	Summarize the structure activity relationship and route of	PO1, PO2, PO4,



	synthesis of various drugs.	PEO1, PEO2, PEO3
CO4	Comparedifferent generation of drugs and their chemical and pharmacological advances	PO1, PO2, PO4, PEO1, PEO2, PEO3

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-501T	Medicinal Chemistry II-Theory	3	2	2	2	3	-	-	-	-	-	-	-	3	3	3

1=weakly mapped

2= moderately mapped

3=strongly mapped

Industrial Pharmacy I- Theory (TIU-UBP-502T)

Contact hours- 45 Hours

Course Objectives

1. To know the various pharmaceutical dosage forms and their manufacturing techniques.
2. To know various considerations in development of pharmaceutical dosage forms.
3. To formulate solid, liquid and semisolid dosage forms and evaluate them for their quality.

Course Outcomes

Upon completion of the course, the student shall be able

CO1.**Explain**the role of physico-chemical factors in preformulation of pharmaceutical dosage form.

CO2.**Illustrate** the formulation development of tablets and liquid oral preparations.

CO3.**Describethe** formulation development of capsules dosage forms.



CO4. **Explicate** the concepts of dosage form design & formulation strategies of pharmaceutical aerosols, parenteral products, ophthalmic preparations and cosmetics.

CO5: **Elucidate** about the legal and official requirements of pharmaceutical packaging

Course Content

UNIT-I

07 Hours

Preformulation Studies: Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances.

a. Physical properties: Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism

b. Chemical Properties: Hydrolysis, oxidation, reduction, racemisation, polymerization
BCS classification of drugs & its significance

Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.

UNIT-II

10 Hours

Tablets:

a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling.

b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating.

c. Quality control tests: In process and finished product tests

Liquid orals: Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia

UNIT-III

08

Hours

Capsules:

a. **Hard gelatin capsules:** Introduction, Production of hard gelatin capsule shells. Size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules.

b. **Soft gelatin capsules:** Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.

Pellets: Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets

UNIT IV

10 Hours

Parenteral Products:



- a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity
- b. Production procedure, production facilities and controls, aseptic processing
- c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.
- d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

Ophthalmic Preparations: Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations

UNIT V

10 Hours

Cosmetics: Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.

Pharmaceutical Aerosols: Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.

Packaging Materials Science: Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.

Reference Books (Latest Editions)

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman & J.B. Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman
7. Pharmaceutics- The science of dosage form design by M.E. Aulton, Churchill livingstone, Latest edition
8. Introduction to Pharmaceutical Dosage Forms by H. C. Ansel, Lea & Febiger, Philadelphia, 5th edition, 2005
9. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs



	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Explain preformulation as a prerequisite of designing a dosage form, physico-chemical principles guiding the selection of appropriate formulation strategy.	PO1, PO2, PO4, PO5, PO11, PO12, PEO1, PEO2, PEO3
CO2	Learn the concept, types, pharmacopoeial specifications, techniques & equipments used in liquid oral and tablet formulation, various tablet additives, manufacture & evaluation, equipments, defects in tableting & remedies, tablet coating.	PO1, PO2, PO4, PO5, PO12, PEO1, PEO2
CO3	Describe capsules, types, additives, size selection, manufacturing & evaluation, equipments, & defects.	PO1, PO2, PO4, PO5, PO12, PEO1, PEO2
CO4	Understand the concepts of dosage form design & formulation strategies of pharmaceutical aerosols, parenteral products, ophthalmic preparations and cosmetics.	PO1, PO4, PO12, PEO1, PEO2
CO5	Know about the legal and official requirements of pharmaceutical packaging	PO1, PO2, PO12, PEO1, PEO2

Course Code	Course Title	Pharmaceutical Knowledge	Problem solving	Conduct, analyze and interpret data	Ability to design and formulating a process	Ability to understand mechanism	Demonstrate skills in problem solving	Professional and ethical responsibilities	Communication to present a technical report	Impact on society and responsibilities	Leadership qualities	Self educating and Life-long Learning	Preparation for competitive examinations	Building a theoretical knowledge base along with necessary practical skills	To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital	Training students to achieve expertise
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-502T	Industrial Pharmacy I- Theory	3	3	-	3	2	-	-	-	-	-	2	3	3	3	2

1=weakly mapped

2= moderately mapped

3=strongly mapped



Industrial Pharmacy I– Practical (TIU-UBP-506P)

Contact hours: 4 hrs/ week

Course Objectives

1. To explain formulation, evaluation, packaging and labelling requirements of tablets, capsules, cream, ophthalmic and parenteral preparations.
2. To describe use of ingredients in formulation and the category of the formulation.
3. To Describe preformulation studies of drug molecules and quality control tests to evaluate the drug manufacturing process relevant to industry.

Course Outcomes:

After successful completion of this course, students will be able to:

CO1. **Describe** the correct use of various equipments in Pharmaceutics laboratory relevant to tablets, capsules & coating.

CO2. **Explain** preformulation of drug and formulation, evaluation, labelling of tablets & capsules.

CO3. **Identify** the rationale behind use of formulation ingredients while preparing cream, ophthalmic and parenteral products.

CO4. **Demonstrate** labels to suit regulatory requirements, to learn the conduct survey and report its finding.

Course Content

4 Hours / week

1. Preformulation studies on paracetamol/aspirin/or any other drug
2. Preparation and evaluation of Paracetamol tablets
3. Preparation and evaluation of Aspirin tablets
4. Coating of tablets- film coating of tablets/granules
5. Preparation and evaluation of Tetracycline capsules
6. Preparation of Calcium Gluconate injection
7. Preparation of Ascorbic Acid injection
8. Quality control test of (as per IP) marketed tablets and capsules
9. Preparation of Eye drops/ and Eye ointments
10. Preparation of Creams (cold / vanishing cream)
11. Evaluation of Glass containers (as per IP)

Reference Books (Latest Editions)

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman & J.B. Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition



5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman
7. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition
8. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5thedition, 2005
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Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Describe the correct use of various equipments in Pharmaceutics laboratory relevant to tablets, capsules & coating	PO1, PO4, PEO1, PEO2, PEO3
CO2	Explain preformulation of drug and formulation, evaluation, labelling of tablets & capsules	PO1, PO4, PO12, PEO1, PEO2, PEO3
CO3	Understand rationale behind use of formulation ingredients while preparing cream, ophthalmic and parenteral products	PO1, PO4, PO12, PEO1, PEO2, PEO3
CO4	Prepare labels to suit regulatory requirements along with conduct survey and report its finding	PO1, PO2, PO3, PO4, PEO1

Course Code	Course Title	Course Outcomes (COs)										Program Outcomes (POs)				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-506P	Industrial Pharmacy I-	3	2	2	2	-	-	-	-	-	-	-	2	3	2	2



Practical																	
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- 1=weakly mapped
2= moderately mapped
3=strongly mapped

PHARMACOLOGY II- Theory (TIU-UBP-503T)

Contact hours: 45 hrs

Course Objectives

1. To know the mechanism of drug action and its relevance in the treatment of different diseases.
2. To administer the knowledge and techniques required for isolation of different organs/tissues from the laboratory animals by simulated experiments.
3. To understand the various receptor actions using isolated tissue preparation.
4. To have an overall idea about pharmacology with related medical sciences.
5. To gain knowledge about pharmacology of drugs acting on different systems in our body.

Course Outcomes

Upon completion of the course, the student shall be able

CO1. **Describe** the mechanism of drug action and its relevance in the treatment of different diseases.

CO2. **Identify** different organs/tissues from the laboratory animals by simulated experiments CO3. Summarize the various receptor actions using isolated tissue preparation.

CO4. **Explain** the therapeutic effects, clinical uses, side effects and contraindication of drugs acting on different systems of body.

CO5. **Summarize** pharmacology with related medical sciences.

Course Content

45 Hours

UNIT-I

10 Hours

Pharmacology of drugs acting on cardio vascular system
Introduction to hemodynamic and electrophysiology of heart.
Drugs used in congestive heart failure
Anti-hypertensive drugs.
Anti-anginal drugs.
Anti-arrhythmic drugs.
Anti-hyperlipidemic drugs.



UNIT-II

10 Hours

Pharmacology of drugs acting on cardio vascular system

Drug used in the therapy of shock.

Hematinics, coagulants and anticoagulants.

Fibrinolytics and anti-platelet drugs

Plasma volume expanders

Pharmacology of drugs acting on urinary system

Diuretics

Anti-diuretics.

UNIT-III

10 Hours

Autocoids and related drugs

Introduction to autocoids and classification

Histamine, 5-HT and their antagonists.

Prostaglandins, Thromboxanes and Leukotrienes.

Angiotensin, Bradykinin and Substance P.

Non-steroidal anti-inflammatory agents

Anti-gout drugs

Antirheumatic drugs

UNIT IV

08 Hours

Pharmacology of drugs acting on endocrine system

Basic concepts in endocrine pharmacology.

Anterior Pituitary hormones- analogues and their inhibitors.

Thyroid hormones- analogues and their inhibitors.

Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D.

Insulin, Oral Hypoglycemic agents and glucagon.

ACTH and corticosteroids.

UNIT V

07 Hours

Pharmacology of drugs acting on endocrine system

Androgens and Anabolic steroids.

Estrogens, progesterone and oral contraceptives.

Drugs acting on the uterus.

Bioassay

Principles and applications of bioassay.

Types of bioassay

Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT



Reference Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins.
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craig & Robert.
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
5. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Describe the mechanism of drug action and its relevance in the treatment of different diseases.	PO1, PO5, PO11, PEO1
CO2	Identify different organs/tissues from the laboratory animals by simulated experiments	PO1, PEO2, PEO3
CO3	Summarize the various receptor actions using isolated tissue preparation.	PO1, PO5, PO12, PEO2, PEO1
CO4	Explain the therapeutic effects, clinical uses, side effects and contraindication of drugs acting on different systems of body.	PO1, PO3, PO5, PO11, PEO2, PO12
CO5	Summarize pharmacology with related medical sciences.	PO1, PO11, PEO2, PEO3



Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-503T	Pharmacology II- Theory	3	-	2	-	3	-	-	-	-	-	3	3	3	3	2

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2= moderately mapped

3=strongly mapped

Pharmacology II–Practical (TIU-UBP-507P)

Contact hours: 4 hr/week

Course Objectives

1. To know the *in-vitro* pharmacology.
2. To administer the knowledge and techniques required for isolation of different organs/tissues from the laboratory animals by simulated experiments.
3. To understand the concept of various receptor actions using isolated tissue preparation.

Course Outcomes:

After successful completion of this course, students will be able to:

CO1. **Demonstrate** *in vitro* pharmacology.

CO2. **Identify** the action of drugs in different isolated organs.

CO3. **Demonstrate** bioassay by using different isolated organs from the laboratory animals by simulated experiments.

CO4. **Distinguish** the drugs by using different animal models.



Course Content

4Hrs/Week

1. Introduction to in-vitro pharmacology and physiological salt solutions.
2. Effect of drugs on isolated frog heart.
3. Effect of drugs on blood pressure and heart rate of dog.
4. Study of diuretic activity of drugs using rats/mice.
5. DRC of acetylcholine using frog rectus abdominis muscle.
6. Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively.
7. Bioassay of histamine using guinea pig ileum by matching method.
8. Bioassay of oxytocin using rat uterine horn by interpolation method.
9. Bioassay of serotonin using rat fundus strip by three point bioassay.
10. Bioassay of acetylcholine using rat ileum/colon by four point bioassay.
11. Determination of PA₂ value of prazosin using rat anococcygeus muscle (by Schilds plot method).
12. Determination of PD₂ value using guinea pig ileum.
13. Effect of spasmogens and spasmolytics using rabbit jejunum.
14. Anti-inflammatory activity of drugs using carrageenan induced paw-edema model.
15. Analgesic activity of drug using central and peripheral methods

Reference Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
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5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.
6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craig & Robert.
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs	
Course Outcomes (COs)	Mapped Program Outcomes



CO1	Demonstrate <i>in vitro</i> pharmacology.	PO1, PO3, PO6, PEO1
CO2	Identify the action of drugs in different isolated organs.	PO1, PO12, PEO1, PEO2, PEO3
CO3	Demonstrate bioassay by using different isolated organs from the laboratory animals by simulated experiments.	PO1, PO2, PO3, PO6, PO12
CO4	Distinguish the drugs by using different animal models.	PO1, PO4, PO5, PO12, PEO1, PEO2, PEO3

		Pharmaceutical Knowledge	Problem solving	Conduct, analyze and interpret data	Ability to design and formulating a process	Ability to understand mechanism	Demonstrate skills in problem solving	Professional and ethical responsibilities	Communication to present a technical report	Impact on society and responsibilities	Leadership qualities	Self educating and Life-long Learning	Preparation for competitive examinations	Building a theoretical knowledge base along with necessary practical skills	To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital Pharmacy	Training students to achieve expertise
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-507P	Pharmacology II - Practical	3	2	2	2	2	2	-	-	-	-	-	2	3	2	2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Pharmacognosy and Phytochemistry II- Theory (TIU-UBP-504T)

Contact hours: 45 hr

Course Objectives

1. To provide basic understanding about plant biogenetic pathways and secondary metabolite formation.
2. To impart an in-depth knowledge about modern extraction techniques of phytoconstituents.
3. To provide fundamental knowledge spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.
4. To gain knowledge about industrial production, estimation and utilization of phytoconstituents.



Course Outcomes

Upon completion of the course, the student shall be able to

CO1. **Acquire** the knowledge about metabolic pathways in order to understand the mechanism of secondary metabolites formation in plants.

CO2. **Apply** the concept of radioactive isotopes in the investigation of Biogenetic pathways.

CO3. **Understand** the composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of secondary metabolites.

CO4. **Demonstrate** the role of spectroscopy and chromatographic techniques in isolation, purification and identification of phytoconstituents.

CO5. **Acquire** an indepth understanding about industrial productions of phytoconstituents

Course Content

45 Hours

UNIT-I

7 Hours

Metabolic pathways in higher plants and their determination

- Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway.
- Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.

UNIT-II

14

Hours

General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites:

Alkaloids: Vinca, Rauwolfia, Belladonna, Opium,

Phenylpropanoids and Flavonoids: Lignans, Tea, Ruta

Steroids, Cardiac Glycosides & Triterpenoids: Liquorice, Dioscorea, Digitalis

Volatile oils: Mentha, Clove, Cinnamon, Fennel, Coriander,

Tannins: Catechu, Pterocarpus

Resins: Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony

Glycosides: Senna, Aloes, Bitter Almond

Iridoids, Other terpenoids & Naphthaquinones: Gentian, Artemisia, taxus, carotenoids

UNIT-III

6

Hours

Isolation, Identification and Analysis of Phytoconstituents

a) Terpenoids: Menthol, Citral, Artemisin

b) Glycosides: Glycyrrhetic acid & Rutin

c) Alkaloids: Atropine, Quinine, Reserpine, Caffeine

d) Resins: Podophyllotoxin, Curcumin

UNIT-IV

10

Hours

Industrial production, estimation and utilization of the following phytoconstituents: Forskolin,

Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine



UNIT V

8

Hours

Basics of Phytochemistry

Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.

Recommended Books: (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, NiraliPrakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), IstEdn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr. SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and Pos		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Acquire the knowledge about metabolic pathways in order to understand the mechanism of secondary metabolites formation in plants.	PO1,PO5,PO11,PO12,
CO2	Apply the concept of radioactive isotopes in the investigation of Biogenetic pathways.	PO1,PO5,PO12,PEO1,PEO2
CO3	Understand the composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of secondary metabolites.	PO1, PO5, PO12,PEO1,
CO4	Demonstrate the role of spectroscopy and chromatographic techniques in isolation, purification and identification of phytoconstituents.	PO1,PO3,PO12, PEO1, PEO2,PEO3
CO5	Acquire an indepth understanding about industrial productions of phytoconstituents	PO1,PEO2, PO12,PEO3



Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-504T	Pharmacognosy and Phytochemistry II - Theory	3	-	2	-	2	-	-	-	-	-	2	3	2	3	2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Pharmacognosy and Phytochemistry II- Practical (TIU-UBP-508P)

Contact hours: 4 hrs/wk

Course Objectives

1. To know the fundamentals of crude drug analysis obtained from natural sources and its industrial utility.
2. To administer the knowledge and techniques required for evaluation of herbal drugs.
3. To understand the concept of quantitative microscopy and its application in QC testing.

Course Outcomes:

After successful completion of this course, students will be able to:

- CO1. **Demonstrate** chemical tests for crude drugs
 CO2. **Evaluate** the quality and purity of crude drugs
 CO3. **Describe** linear measurements for crude drug identification
 CO4. **Develop** quality control methods for standardisation of herbal drug

Course Content Hours/Week

4

1. Analysis of crude drugs by chemical tests: (i)Tragacanth (ii) Acacia (iii)Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil
2. Determination of stomatal number and index



3. Determination of vein islet number, vein islet termination and palisade ratio.
4. Determination of Ash value
6. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer
7. Determination of Fiber length and width
8. Determination of number of starch grains by Lycopodium spore method
9. Determination of Extractive values of crude drugs
10. Determination of moisture content of crude drugs
11. Determination of swelling index and foaming

Reference Books (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, NiraliPrakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), IstEdn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. Iyengar

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Demonstrate chemical tests for unorganized crude drugs and its analysis	PO1,PO3,PO6,PEO1
CO2	Evaluate the quality and purity of crude drugs	PO1,PO12,PEO1,PEO2, PEO3
CO3	Describe linear measurements for crude drug identification using microscopical techniques	PO1,PO2,PO3,PO6,PO12
CO4	Develop quality control methods for standardisation of herbal drug	PO1,PO4,PO5,PO12, PEO1,PEO2, PEO3



Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-508P	Pharmacognosy and Phytochemistry II- Practical	3	2	2	2	2	2	-	-	-	-	-	2	3	2	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

Pharmaceutical Jurisprudence –Theory (TIU-UBP-505T)
Contact hours- 45 hr

Course Objectives:-

- 1.To know the Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.
- 2.To know Various Indian pharmaceutical Acts and Laws
- 3.To know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
4. Appreciate the code of ethics during the pharmaceutical practice.

Course Outcomes

Upon completion of the course, the student shall be able

- CO-1.**Recognize** the various importance of professional and ethical responsibilities as per Pharmaceutical jurisprudence and global regulations.
- CO-2.**Demonstrate** regarding different regulation in pharma industry
- CO-3.**Illustrate** about the ethics and responsibility of a pharmacist
- CO-4.**Describe** pharmaceutical ethics and laws related to pharmaceutical industry.

Course Content

45 Hours



Unit – 1:-

7h

Drugs and Cosmetics Act, 1940 and its rules 1945: Objectives, Definitions, Legal definitions of schedules to the Act and Rules Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties. Manufacture of drugs – Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.

Unit -2:-

7h

Drugs and Cosmetics Act, 1940 and its rules 1945.

Detailed study of Schedule G, H, M, N, P, T, U, V, X, Y, Part XII B, Sch F & DMR (OA) Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties Labelling & Packing of drugs- General labelling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties. Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors.

Unit- 3:-

3h

Pharmacy Act –1948: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, Describe and Joint Describe pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and Penalties

Unit -4:-

3h

Medicinal and Toilet Preparation Act –1955: Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. Offences and Penalties.

Unit -5:-

3h

Narcotic Drugs and Psychotropic substances Act-1985 and Rules: Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties.

Unit- 6:-

2h

Study of Salient Features of Drugs and Magic Remedies Act and its rules: Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties



Unit-7:- **2h**

Prevention of Cruelty to animals Act-1960: Objectives, Definitions, Institutional Animal Ethics Committee, CPCSEA guidelines for Breeding and Stocking of Animals, Describeance of Experiments, Transfer and acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties.

Unit 8:- **5h**

National Pharmaceutical Pricing Authority: Drugs Price Control Order (DPCO)- 2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM)

Unit -9:- **3h**

Pharmaceutical Legislations – A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee

Unit 10:- **3h**

Code of Pharmaceutical ethics Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath

Unit 11:- **7h**

Medical Termination of Pregnancy Act
Right to Information Act
Introduction to Intellectual Property Rights

Reference Books (Latest Editions)

Forensic Pharmacy by B. Suresh
Text book of Forensic Pharmacy by B.M. Mithal
Hand book of drug law-by M. L. Mehra
A text book of Forensic Pharmacy by N.K. Jain
Drugs and Cosmetics Act/Rules by Govt. of India publications.
Medicinal and Toilet preparations act 1955 by Govt. of India publications.
Narcotic drugs and psychotropic substances act by Govt. of India publications
Drugs and Magic Remedies act by Govt. of India publication
Bare Acts of the said laws published by Government. Reference books (Theory)

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs



	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Recognize the various importance of professional and ethical responsibilities as per Pharmaceutical jurisprudence and global regulations.	PO1, PO12, PEO1, PEO2, PO7
CO2	Demonstrate regarding different regulation in pharma industry	PO1, PO4, PO5, PEO2, PO7
CO3	Illustrate the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals	PO1, PO5, PO12, PEO1, PEO2, PEO3, PO7
CO4	Identification of different problem and solve with the law's of industry.	PO1, PO2, PO3, PO6, PEO1, PEO2, PO7

Course Code	Course Title	Pharmaceutical Knowledge Problem solving Conduct, analyze and interpret data Ability to design and formulating a process Ability to understand mechanism Demonstrate skills in problem solving Professional and ethical responsibilities Communication to present a technical report Impact on society and responsibilities Leadership qualities Self educating and Life-long Learning Preparation for competitive examinations Building a theoretical knowledge base along with necessary practical skills To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital Training students to achieve expertise														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-505T	Pharmaceutical Jurisprudence-Theory	3	3	3	2	2	3	2	-	-	-	-	3	3	3	2

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