PHARM. D SIX YEAR DEGREE PROGRAM

PROGRAM CURRICULUM

(Applicable for the batches admitted from A.Y 2025-26)

DOCTOR OF PHARMACY

ADITYA UNIVERSITY

Aditya Nagar, ADB Road, Surampalem - 533 437

ADITYA UNIVERSITY

Vision

- To be a globally recognized university through excellence in Education, Innovation and Sustainable growth.

Mission

Deliver collaborative education to prepare students for global challenges through

- Transformative learning
- Vibrant research ecosystem
- Sustainable and inclusive community

School of Pharmacy

Vision:

To emerge as a center of excellence producing competent, ethical pharmacists and researchers through holistic education and lifelong learning.

Mission:

- Empower future pharmacists through outcome-based learning for global healthcare challenges.
- Promote collaborative research for national and global healthcare impact.
- Ensure integrity, inclusion, and accountability in global healthcare education.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

Graduates of the Program will:

PEO 1: Contribute to healthcare through evidence-based and ethical practices.

PEO 2: Excel in pharmacy research and entrepreneurship driving therapeutic innovations.

PEO 3: Pursue continuous development and adapt to evolving healthcare technologies.

PROGRAMME SPECIFIC OUTCOMES (PSO)

After successful completion of the program, the graduates will be able to

PSO1: Design, formulate, and evaluate medicinal products with quality and regulatory compliance.

PSO2: Provide therapeutic information and promote rational medication use in clinical settings.

PROGRAMME OUTCOMES (PO)

After successful completion of the program, the graduates will be able to

PO1: Pharmacy Knowledge

Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioral, social, and administrative pharmacy sciences; and manufacturing practices. PO2: Planning Abilities

Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines.

PO3: Problem analysis

Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.

PO4: Modern tool usage

Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.

PO5: Leadership skills

Understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfillment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizens or leadership roles when appropriate to facilitate improvement in health and well-being.

PO6: Professional Identity

Understand, analyze and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).

PO7: Pharmaceutical Ethics

Honour personal values and apply ethical principles in professional and social contexts.

Demonstrate behavior that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.

PO8: Communication

Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions.

PO9: The Pharmacist and society

Apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.

PO10: Environment and sustainability

Understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO11: Life-long learning

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Self-assess and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.

School of Pharmacy

Pharm D Program Curriculum – 2025

(Applicable for the batches admitted from A.Y 2025-26)

CATEGORY-WISE COURSE DIVISION

S.No	Broad Category of Course
1.	Major Core Courses (MCC)
2.	Ability Enhancement Courses (AEC)
3.	Skill Enhancement Courses (SEC)
4.	Internship (PROJ)

Foundation Courses – FC

Intermediate Courses –IC

Advanced Courses - AC

MCC (Major Core Courses)

Course Code	Year	Course Name	Level	Hours			CIE	YEE	Total
				L	T	P			
2516PY01	I	Human Anatomy and Physiology	FC	3	1		30	70	100
2516PY02		Pharmaceutics	FC	2	1		30	70	100
2516PY03		Medicinal Biochemistry	FC	3	1		30	70	100
2516PY04		Pharmaceutical Organic Chemistry	FC	3	1		30	70	100
2516PY05		Pharmaceutical Inorganic Chemistry	FC	2	1		30	70	100
2516PY07		Human Anatomy and Physiology	FC			3	30	70	100
2516PY08		Pharmaceutics	FC			3	30	70	100
2516PY09		Medicinal Biochemistry	FC			3	30	70	100
2516PY10		Pharmaceutical Organic Chemistry	FC			3	30	70	100
2516PY11		Pharmaceutical Inorganic Chemistry	FC			3	30	70	100
2516PY13	II	Pathophysiology	IC	3	1		30	70	100
2516PY14		Pharmaceutical Microbiology	IC	3	1		30	70	100
2516PY15		Pharmacognosy & Phytopharmaceuticals	IC	3	1		30	70	100
2516PY16		Pharmacology-I	IC	3	1		30	70	100
2516PY18		Pharmacotherapeutics-I	IC	3	1		30	70	100
2516PY19		Pharmaceutical Microbiology	IC			3	30	70	100
2516PY20		Pharmacognosy & Phytopharmaceuticals	IC			3	30	70	100
2516PY21		Pharmacotherapeutics-I	IC			3	30	70	100
2516PY22	III	Pharmacology-II	IC	3	1		30	70	100
2516PY23		Pharmaceutical Analysis	IC	3	1		30	70	100
2516PY24		Pharmacotherapeutics-II	IC	3	1		30	70	100
2516PY26		Medicinal Chemistry	IC	3	1		30	70	100
2516PY27		Pharmaceutical Formulations	IC	2	1		30	70	100
2516PY28		Pharmacology-II	IC			3	30	70	100

2516PY29		Pharmaceutical Analysis	IC			3	30	70	100
2516PY30		Pharmacotherapeutics-II	IC			3	30	70	100
2516PY31		Medicinal Chemistry	IC			3	30	70	100
2516PY32		Pharmaceutical Formulations	IC			3	30	70	100
2516PY33	IV	Pharmacotherapeutics-III	AC	3	1		30	70	100
2516PY34		Hospital Pharmacy	AC	2	1		30	70	100
2516PY35		Clinical Pharmacy	AC	3	1		30	70	100
2516PY37		Biopharmaceutics & Pharmacokinetics	AC	3	1		30	70	100
2516PY38		Clinical Toxicology	AC	2	1		30	70	100
2516PY39		Pharmacotherapeutics-III	AC			3	30	70	100
2516PY40		Hospital Pharmacy	AC			3	30	70	100
2516PY41		Clinical Pharmacy	AC			3	30	70	100
2516PY42		Biopharmaceutics &Pharmacokinetics	AC			3	30	70	100
2516PY43	V	Clinical Research	AC	3	1		30	70	100
2516PY45		Clinical Pharmacokinetics & Drug Monitoring	AC	2	1		30	70	100
2516PY44		Pharmacoepidemiology & Pharmacoeconomics	AC	3	1		30	70	100
Total				**63**	**23**	**51**			

AEC (Ability Enhancement Course)

Course Code	Year	Course Name	Level	Hours			CIE	YEE	Total
				L	T	P			
2516PY06	I	Remedial Biology/	FC	3	1		30	70	100
2516PY49	I	Remedial Mathematics							
2516PY12	I	Remedial Biology Practical	FC			3	30	70	100
2516PY25	III	Pharmaceutical Jurisprudence	IC	2	1		30	70	100
2516PY50	VI	Student Activity Based Learning	AC						
Total				**5**	**2**	**3**			

SEC (Skill Enhancement Course)

Course Code	Year	Course Name	Level	Hours			CIE	YEE	Total
				L	T	P			
2516PY17	II	Community Pharmacy	IC	2	1		30	70	100
2516PY36	IV	Biostatistics & Research Methodology	AC	2	1		30	70	100
Total				**4**	**2**				

PROJ (Project Work / Internship)

Course Code	Year	Course Name	Level	Hours			CIE	YEE	Total
				L	T	P			
2516PY46	V	Clerkship	AC			1	30	70	100
2516PY47	V	Project Work	AC			20		100	100
2516PY48	VI	Internship/Residency in Specialty Units	AC			40	Score 0-5		
Total						**61**			

LEVEL-WISE COURSES

	Foundation Courses (FC)		Intermediate- Level Courses (IC)		Advanced Courses (AC)
HAP (T)	Human Anatomy and Physiology	PP	Pathophysiology	PT-III (T)	Pharmacotherapeutics-III
Pceu (T)	Pharmaceutics	PM (T)	Pharmaceutical Microbiology	HP (T)	Hospital Pharmacy
MBC (T)	Medicinal Biochemistry	PCPP (T)	Pharmacognosy & Phytopharmaceuticals	CP (T)	Clinical Pharmacy
POC (T)	Pharmaceutical Organic Chemistry	PC-I (T)	Pharmacology-I	BSRM	Biostatistics & Research Methodology
PIC (T)	Pharmaceutical Inorganic Chemistry	CP	Community Pharmacy	BPPK (T)	Biopharmaceutics & Pharmacokinetics
RM (T)/RB (T)	Remedial Mathematics / Biology	PT-I (T)	Pharmacotherapeutics-I	CT	Clinical Toxicology
HAP (P)	Human Anatomy and Physiology	PM (P)	Pharmaceutical Microbiology	PT-III (P)	Pharmacotherapeutics-III
Pceu (P)	Pharmaceutics	PCPP (P)	Pharmacognosy & Phytopharmaceuticals	HP (P)	Hospital Pharmacy
MBC (P)	Medicinal Biochemistry	PT-I (P)	Pharmacotherapeutics-I	CP (P)	Clinical Pharmacy
POC (P)	Pharmaceutical Organic Chemistry	PC-II (T)	Pharmacology-II	BPPK (P)	Biopharmaceutics & Pharmacokinetics
PIC (P)	Pharmaceutical Inorganic Chemistry	PA(T)	Pharmaceutical Analysis	CR	Clinical Research
RM (P)/RB (P)	Remedial Mathematics / Biology	PT-II (T)	Pharmacotherapeutics-II	PEPE	Pharmacoepidemiology & Pharmacoeconomics
HAP (T)	Human Anatomyand Physiology	PJ	Pharmaceutical Jurisprudence	CPDM	Clinical Pharmacokinetics & Drug Monitoring
		MC (T)	Medicinal Chemistry	CS	Clerkship
		PF (T)	Pharmaceutical Formulations	PW	Project Work
		PC- II (P)	Pharmacology-II	Int/RSU	Internship / Residency in Speciality Units
		PA(P)	Pharmaceutical Analysis	PT-III (T)	Pharmacotherapeutics-III
		PT-II (P)	Pharmacotherapeutics-II		
		MC (P)	Medicinal Chemistry		
		PF (P)	Pharmaceutical Formulations		
		PP	Pathophysiology		

Year wise Curriculum

Year 1

Course Code	Course Name	Category	Level	Hours			Total
				L	T	P	
2516PY01	Human Anatomy and Physiology	MCC	FC	3	1		4
2516PY02	Pharmaceutics	MCC	FC	2	1		3
2516PY03	Medicinal Biochemistry	MCC	FC	3	1		4
2516PY04	Pharmaceutical Organic Chemistry	MCC	FC	3	1		4
2516PY05	Pharmaceutical Inorganic Chemistry	MCC	FC	2	1		3
2516PY49 (OR) 2516PY06	Remedial Mathematics (OR) Biology	AEC	FC	3	1		4
2516PY07	Human Anatomy and Physiology Practical	MCC	FC			3	3
2516PY08	Pharmaceutics Practical	MCC	FC			3	3
2516PY09	Medicinal Biochemistry Practical	MCC	FC			3	3
2516PY10	Pharmaceutical Organic Chemistry Practical	MCC	FC			3	3
2516PY11	Pharmaceutical Inorganic Chemistry Practical	MCC	FC			3	3
2516PY12	Remedial Biology Practical	AEC	FC			3	3
Total				**16**	**6**	**18**	**40**

Year 2

Course Code	Course Name	Category	Level	Hours			Total
				L	T	P	
2516PY13	Pathophysiology	MCC	IC	3	1		4
2516PY14	Pharmaceutical Microbiology	MCC	IC	3	1		4
2516PY15	Pharmacognosy & Phytopharmaceuticals	MCC	IC	3	1		4
2516PY16	Pharmacology-I	MCC	IC	3	1		4
2516PY17	Community Pharmacy	SEC	IC	2	1		3
2516PY18	Pharmacotherapeutics-I	MCC	IC	3	1		4
2516PY19	Pharmaceutical Microbiology Practical	MCC	IC			3	3
2516PY20	Pharmacognosy & Phytopharmaceuticals Practical	MCC	IC			3	3
2516PY21	Pharmacotherapeutics-I Practical	MCC	IC			3	3
Total				**17**	**6**	**9**	**32**

Year 3

Course Code	Course Name	Category	Level	Hours			Total
				L	T	P	
2516PY22	Pharmacology-II	MCC	IC	3	1		4
2516PY23	Pharmaceutical Analysis	MCC	IC	3	1		4
2516PY24	Pharmacotherapeutics-II	MCC	IC	3	1		4
2516PY25	Pharmaceutical Jurisprudence	AEC	IC	2			2
2516PY26	Medicinal Chemistry	MCC	IC	3	1		4
2516PY27	Pharmaceutical Formulations	MCC	IC	2	1		3
2516PY28	Pharmacology-II Practical	MCC	IC			3	3
2516PY29	Pharmaceutical Analysis Practical	MCC	IC			3	3
2516PY30	Pharmacotherapeutics-II Practical	MCC	IC			3	3
2516PY31	Medicinal Chemistry Practical	MCC	IC			3	3
2516PY32	Pharmaceutical Formulations Practical	MCC	IC			3	3
Total				**16**	**5**	**15**	**36**

Year 4

Course Code	Course Name	Category	Level	Hours			Total
				L	T	P	
2516PY33	Pharmacotherapeutics-III	MCC	AC	3	1		4
2516PY34	Hospital Pharmacy	MCC	AC	2	1		3
2516PY35	Clinical Pharmacy	MCC	AC	3	1		4
2516PY36	Biostatistics & Research Methodology	SEC	AC	2	1		3
2516PY37	Biopharmaceutics & Pharmacokinetics	MCC	AC	3	1		4
2516PY38	Clinical Toxicology	MCC	AC	2	1		3
2516PY39	Pharmacotherapeutics-III Practical	MCC	AC			3	3
2516PY40	Hospital Pharmacy Practical	MCC	AC			3	3
2516PY41	Clinical Pharmacy Practical	MCC	AC			3	3
2516PY42	Biopharmaceutics & Pharmacokinetics Practical	MCC	AC			3	3
Total				**15**	**6**	**12**	**33**

Year 5

Course Code	Course Name	Category	Level	Hours			Total
				L	T/S	P	
2516PY43	Clinical Research	MCC	AC	3	1		4
2516PY44	Pharmacoepidemiology & Pharmacoeconomics	MCC	AC	3	1		4
2516PY45	Clinical Pharmacokinetics & Drug Monitoring	MCC	AC	2	1		3
2516PY46	Clerkship	PROJ	AC		1		1
2516PY47	Project Work	PROJ	AC			20	20
Total				**8**	**3**	**21**	**32**

Year 6

Course Code	Course Name	Category	Level	Hours			Total
				L	T	P	
2516PY48	Internship / Residency in Specialty Units	PROJ	AC			40	40
2516PY50	Student Activity Based Learning	AEC	AC				
Total						**40**	**40**

SYLLABUS

1st YEAR

HUMAN ANATOMY & PHYSIOLOGY -THEORY

Course Code: 2516PY01

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

COB1: Describe the structure (gross and histology) and functions of various organs of the human body;

COB2: Describe the various homeostatic mechanisms and their imbalances of various systems;

COB3: Identify the various tissues and organs of the different systems of the human body;

COB4: Perform the haematological tests and also record blood pressure, heart rate, pulse and Respiratory volumes;

COB5: Appreciate coordinated working pattern of different organs of each system; and

COB6: Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body

Course Outcomes: At the end of the course, the student will be able to

CO1: Describe Scope of anatomy and physiology, basic terminologies used in this subject, Structure of cell – its components and their functions, about Elementary tissues of the human body: epithelial, connective, Muscular and nervous tissues- Their sub-types and characteristics, sk1eletal system.

CO2: Describe about Haemopoietic System, Lymph, and Cardiovascular system.

CO3: Describe about Respiratory system and Digestive system.

CO4: Explain Nervous system, Urinary system**.**

CO5: Describe about Endocrine system and Reproductive system.

CO6: Demonstrate Sense organs, Skeletal system and Sports physiology.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3			2		2	3	3	1	1	3
CO2	3			2		2	3	3	1	1	3
CO3	3			2		2	3	3	1	1	3
CO4	3			2		2	3	3	1	1	3
CO5	3			2		2	3	3	1	1	3
CO6	3			2		2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	3
CO3	3	2
CO4	2	3
CO5	3	2
CO6	2	3

Lecture wise programme: **3 Hrs/Week**

1. **Scope of anatomy and physiology-** basic terminologies used in this subject (Description of the body as such planes and terminologies)

2. **Structure of cell** – its components and their functions.

3. **Elementary tissues of the human body:** epithelial, connective, Muscular and nervous tissues- their sub-types and characteristics

4. **a) Osseous system** - structure, composition and functions of the Skeleton. (done in practical classes - 6hrs)b) Classification of joints, Types of movements of joints and disorders of joints (Definitions only)

5. **Haemopoetic System**

a. Composition and functions of blood

b. Haemopoesis and disorders of blood components (definition of disorder)

c. Blood groups

d. Clotting factors and mechanism

e. Platelets and disorders of coagulation

6. **Lymph**

a. Lymph and lymphatic system, composition, formation and circulation.

b. Spleen: structure and functions, Disorders

c. Disorders of lymphatic system (definition only)

7. **Cardiovascular system**

a. Anatomy and functions of heart

b. Blood vessels and circulation (Pulmonary, coronary and systemic circulation)

c. Electrocardiogram (ECG)

d. Cardiac cycle and heart sounds

e. Blood pressure – its maintenance and regulation

Definition of the following disorders Hypertension, Hypotension, Arteriosclerosis, Atherosclerosis, Angina, Myocardial infarction, Congestive heart failure, and Cardiac arrhythmia

8. **Respiratory system**

a. Anatomy of respiratory organs and functions

b. Mechanism / physiology of respiration and regulation of respiration

c. Transport of respiratory gases

d. Respiratory volumes and capacities, and Definition of: Hypoxia, Asphyxia, Dybarism, Oxygen therapy and resuscitation.

9. **Digestive system**

a. Anatomy and physiology of GIT

b. Anatomy and functions of accessory glands of GIT

c. Digestion and absorption d) Disorders of GIT (definitions only)

10. **Nervous system**

a. Definition and classification of nervous system

b. Anatomy, physiology and functional areas of cerebrum

c. Anatomy and physiology of cerebellum

d. Anatomy and physiology of mid brain

e. Thalamus, hypothalamus and Basal Ganglia

f. Spinal cord: Structure & reflexes – mono-poly-planter

g. Cranial nerves – names and functions

h. ANS – Anatomy & functions of sympathetic & parasympathetic N.S.

11. **Urinary system**

a. Anatomy and physiology of urinary system

b. Formation of urine

c. Renin Angiotensin system – Juxtaglomerular apparatus - acid base Balance

d. Clearance tests and micturition

12. **Endocrine system**

a. Pituitary gland

b. Adrenal gland

c. Thyroid and Parathyroid glands

d. Pancreas and gonads

13. **Reproductive system**

a. Male and female reproductive system

b. Their hormones – Physiology of menstruation

c. Spermatogenesis & Oogenesis

d. Sex determination (genetic basis)

e. Pregnancy and maintenance and parturition

f. Contraceptive devices

14. **Sense organs**

a. Eye

b. Ear

c. Skin

d. Tongue & Nose

15. **Skeletal muscles**

a. Histology

b. Physiology of Muscle contraction

c. Physiological properties of skeletal muscle and their disorders (definitions)

16. **Sports physiology**

a. Muscles in exercise, Effect of athletic training on muscles and muscle performance,

b. Respiration in exercise, CVS in exercise, Body heat in exercise, Body fluids and salts in exercise,

c. Drugs and athletics

Text books

1. Tortora Gerard J. and Nicholas, P. Principles of anatomy and physiology Publisher Harpercollins College New York.

2. Wilson, K.J.W. Ross and Wilson's foundations of anatomy and physiology. Publisher: Churchill Livingstone, Edinburg.

Reference books

1. Guyton Arthur, C. Physiology of human body. Publisher: Holtsaunders.

2. Chatterjee, C.C. Human physiology. Volume 1&11. Publisher: medical allied agency, Calcutta.

3. Peter L. Williams, Roger Warwick, Mary Dyson and Lawrence, H.

Web Links:

W1: https://www.pharmaguideline.com/2021/10/forms-of-intracellular-signaling.html **W2:** https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction **W3:** https://www.sth.nhs.uk/clientfiles/File/AP%20and%20%20HF%202019.pdf

W4: https://my.clevelandclinic.org/health/body/22827-integumentary-system

W5:https://pressbooks-dev.oer.hawaii.edu/anatomyandphysiology/chapter/an-overview-of-blood/

HUMAN ANATOMY & PHYSIOLOGY – PRACTICAL

Course Code: 2516PY07

Course Objectives: Upon completion of the course the student shall be able to
COB1: describe the structure (gross and histology) and functions of various organs of the human body;
COB2: describe the various homeostatic mechanisms and their imbalances of various systems; **COB3:** identify the various tissues and organs of the different systems of the human body; **COB4:** perform the hematological tests and also record blood pressure, heart rate, pulse and Respiratory volumes;
COB5: appreciate coordinated working pattern of different organs of each system; and
COB6: appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body

Course Outcomes: At the end of the course, the student will be able to
CO1: Demonstration about microscope, tissues and bones.
CO2: Demonstration on hemocytometry and estimation of WBC, RBC Count.
CO3: Analyse bleeding time, clotting time, hb content, ESR.B.P and Blood group
CO4: Explain about Cardiovascular system, Respiratory system, Digestive system Urinary system, Nervous system, Special senses, and Reproductive system
CO5: Demonstration on family planning and pregnancy diagnosis.
CO6: Analyse record simple muscle curve using gastroenemius sciatic nerve preparation

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3			3		2	3	3	1	1	3
CO2	3			3		2	3	3	1	1	3
CO3	3			3		2	3	3	1	1	3
CO4	3			3			3	3	3	1	3
CO5	3			3		2	3	3	1	1	3
CO6	3			3		2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	3
CO3	2	3
CO4	3	2
CO5	3	2
CO6	2	3

Lecture wise Programme: **3 Hrs/Week**

List of Experiments:

Expt. No	Title	CO
1.	Study of tissues of human body (a) Epithelial tissue. (b) Muscular tissue	CO1
2.	Study of tissues of human body (a) Connective tissue. (b) Nervous tissue.	CO1
3.	Study of appliances used in hematological experiments	CO2
4.	Determination of W.B.C. count of blood.	CO2
5.	Determination of R.B.C. count of blood	CO2
6.	Determination of differential count of blood	CO2
7.	Determination of (a) Erythrocyte Sedimentation Rate. (b) Hemoglobin content of Blood. (c) Bleeding & Clotting time.	CO3
8	Determination of (a) Blood Pressure. (b) Blood group.	CO3
9.	Study of various systems with the help of charts, models & specimens (a) Skeleton system part I-axial skeleton. (b) Skeleton system part II- appendicular skeleton. (c) Cardiovascular system. (d) Respiratory system (e) Digestive system. (f) Urinary system. (g) Nervous system. (h) Special senses. (i) Reproductive system	CO3
10.	Study of different family planning appliances	CO4
11.	To perform pregnancy diagnosis test	CO5
12.	Study of appliances used in experimental physiology	CO5
13.	To record simple muscle curve using gastroenemius sciatic nerve preparation	CO6
14.	To record simple muscle curve using gastroenemius sciatic nerve preparation diagnosis test	CO6
15.	To record simple summation curve using gastroenemius sciatic nerve preparation	CO6
16.	To record simple effect of load & after load using gastroenemius sciatic nerve preparation.	CO6
17.	To record simple fatigue curve using gastroenemius sciatic nerve preparation	CO6

Text Books:

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers' medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York

Reference Books:

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology(vol1 and 2) by Dr. C.C. Chatterrje, Academic Publishers Kolkata

Web Links:

W1: https://www.mountsinai.org/health-library/tests/wbc-count

W2: https://pharmacyinfoline.com/epithelial-and-connective-tissue/

W3:https://www.studocu.com/in/document/marwadi-university/human-anatomy-and- physiology/identification-of-axial-bones/39018884

W4: https://www.practicalclinicalskills.com/blood-pressure-measurement#google_vignette

W5: https://www.medicine.mcgill.ca/physio/vlab/bloodlab/ESR.htm

PHARMACEUTICS (THEORY)

Subject Code: 2516PY02

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

COB1: know the formulation aspects of different dosage forms.

COB2: do different pharmaceutical calculations involved in formulation.

COB3: formulate different types of dosage forms; and

COB4: appreciate the importance of good formulation for effectiveness.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Describe the history of the profession of pharmacy, different dosage forms, professional way of handling the prescription along with they can also understand dose calculation for paediatrics based on different factors.

CO2: Explain about the basics of different pharmacopoeia and national formulary

CO3: Demonstrate the different measuring systems and Preparation of various conventional dosage forms and their stability studies

CO4: Discuss the various preparation methods and stability evaluations of biphasic liquid dosage forms. Assess the Preparation of semisolid dosage forms for body cavity, evaluations

CO5: Explain the basics of pharmaceutical calculations, excipients used indifferent dosage forms.

CO6: Demonstrate various extraction methods by using different equipment's and surgical aids. Classify types of pharmaceutical incompatibilities and their overcoming methods.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3		2	1							3
CO2	3		2	1							2
CO3	3		2	1		2		2	2		2
CO4	3		2	1				2	2	2	2
CO5	3		2	1				1	1		2
CO6	3		2	1				1			1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	1
CO3	1	1
CO4	1	2
CO5	1	1
CO6	1	1

Lecture wise Programme: **2 Hrs/Week**

1 a. Introduction to dosage forms - classification and definitions b. Prescription: definition, parts and handling c. Posology: Definition, Factors affecting dose selection. Calculation of children and infant doses.

2 Historical back ground and development of profession of pharmacy and pharmaceutical industry in brief.

3 Development of Indian Pharmacopoeia and introduction to other Pharmacopoeias such as BP, USP, European Pharmacopoeia, Extra pharmacopoeia and Indian national formulary.

4 Weights and measures, Calculations involving percentage solutions, allegation, proof spirit, isotonic solutions etc.

5 Powders and Granules: Classification advantages and disadvantages, Preparation of simple, compound powders, Insufflations, Dusting powders, Eutectic and Explosive powders, Tooth powder and effervescent powders and granules.

6 Monophasic Dosage forms: Theoretical aspects of formulation including adjuvant like stabilizers, colorants, flavours with examples. Study of Monophasic liquids like gargles, mouth washes, Throat paint, Ear drops, Nasal drops, Liniments and lotions, Enemas and collodions

7 Biphasic dosage forms: Suspensions and emulsions, Definition, advantages and disadvantages, classification, test for the type of emulsion, formulation, stability and evaluation.

8 Suppositories and pessaries: Definition, advantages and disadvantages, types of base, method of preparation, Displacement value and evaluation.

9 Galenicals: Definition, equipment for different extraction processes like infusion, Decoction, Maceration and Percolation, methods of preparation of spirits, tinctures and extracts.

10 Pharmaceutical calculations.

11 Surgical aids: Surgical dressings, absorbable gelatin sponge, sutures, ligatures and medicated bandages.

12 Incompatibilities: Introduction, classification and methods to overcome the incompatibilities

Text books

a. Cooper and Gunns Dispensing for pharmacy students.

b. A text book Professional Pharmacy by N.K. Jain and S.N. Sharma.

Reference books

a. Introduction to Pharmaceutical dosage forms by Howard C. Ansel.

b. Remington's Pharmaceutical Sciences.

c. Register of General Pharmacy by Cooper and Gunn.

Weblinks;

W 1. Pharmacopoeia | Drugs, Formulations, Compounds | Britannica

W2. Types of Powders Explained | Luxwisp

W3. RJPT - Review on Pharmaceutical Calculations

W4. (PDF) PHARMACEUTICAL INCOMPATIBILITES: A REVIEW

W5. N. Deekshitha Reddy, Int. J. of Pharm. Sci., 2024, Vol 2, Issue 2, 668-675

PHARMACEUTICS PRACTICAL

Subject Code: 2516PY08

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

COB1: know the formulation aspects of different dosage forms.

COB2: do different pharmaceutical calculation involved in formulation.

COB3: formulate different types of dosage forms.

COB4: appreciate the importance of good formulation for effectiveness.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Formulate monophasic liquid dosage forms for internal use (Create)

CO2: Design the preparation of monophasic liquid dosage forms for external use.

CO3: Design the preparation of biphasic dosage forms for both internal & external use

CO4: Discuss the preparation and dispensing methods for solid dosage forms like various powders and granules

CO5: Formulate various semisolid dosage forms for body cavity & suppositories

CO6: Demonstrate the various types of incompatibilities and overcoming method

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3		2	1							3
CO2	3		2	1							2
CO3	3		2	1		2		2	2		2
CO4	3		2	1				2	2	2	2
CO5	3		2	1				1	1		2
CO6	3		2	1				1	1		1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	3
CO3	2	3
CO4	3	2
CO5	2	2
CO6	3	3

Lecture wise Programme: **3 Hrs/Week**

List of Experiments:

Expt. No	Title	CO
1.	Syrups a. Simple Syrup I.P b. Syrup of Ephedrine Hcl NF c. Syrup Vasaka IP d. Syrup of ferrous Phosphate IP e. Orange Syrup	**CO1**
2.	Elixir a. Piperazine citrate elixir BP b. Cascara elixir BPC c. Paracetamol elixir BPC	**CO1**
3.	Linctus a. Simple Linctus BPC b. Pediatric simple Linctus BPC	**CO1**
4.	Solutions a. Solution of cresol with soap IP b. Strong solution of ferric chloride BPC c. Aqueous Iodine Solution IP d. Strong solution of Iodine IP e. Strong solution of ammonium acetate IP	**CO1 & CO2**
5.	Liniments a. Liniment of turpentine IP* b. Liniment of camphor IP	**CO2**
6.	Suspensions* a. Calamine lotion b. Magnesium Hydroxide mixture BP	**CO3**
7.	Emulsions* a. Cod liver oil emulsion b. Liquid paraffin emulsion	**CO3**
8.	Powders a. Eutectic powder b. Explosive powder c. Dusting powder d. Insufflations	**CO4**
9.	Suppositories a. Boric acid suppositories b. Chloral suppositories	**CO5**
10.	Incompatibilities a. Mixtures with Physical b. Chemical & Therapeutic incompatibilities	**CO6**

Textbooks:

1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi.
2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.

Reference:

1. M.E. Aulton, Pharmaceutics, The Science& Dosage Form Design, Churchill Livingstone, Edinburgh.
2. Indian pharmacopoeia.
3. British pharmacopoeia.

Weblinks:

W1. (PDF) A review on suppositories

W2. Formulation and Preparation of Water-In-Oil-In-Water Emulsions Loaded with a Phenolic-Rich Inner Aqueous Phase by Application of High Energy Emulsification Methods - PMC

W3. Simple & Compound Powders– Official Preparations | Pharmaguideline

W4.(PDF) Medicated ointments: Methods of preparation, Mode of Action, Physico chemical characteristics- An overview

MEDICINAL BIOCHEMISTRY (Theory)

Coure code: 2516PY03

Course objectives: On completion of this course the student will able to

COB 1: understand the catalytic activity of enzymes and importance of isoenzymes in diagnosis of diseases

COB 2: know the metabolic process of biomolecules in health and illness (metabolic disorders);

COB 3: understand the genetic organization of mammalian genome; protein synthesis; replication; mutation and repair mechanism.

COB 4: know the biochemical principles of organ function tests of kidney, liver and endocrine gland

COB 5: understand how to perform qualitative analysis and determination of biomolecules in the body fluids

Course Outcomes: At the end of the course, the student will be able to:

CO1: Summarise Cell and its biochemical organization.

CO2: Characterise the catalytic activity of enzymes and importance of isoenzymes in diagnosis of diseases.

CO3: State the metabolic process of bio molecules in health and illness (metabolic disorders).

CO4: Justify the genetic organization of mammalian genome, protein synthesis, replication, mutation and repair mechanism.

CO5: Illustrate the biochemical principles of organ function tests of kidney, liver and endocrine gland.

CO6: Describe the qualitative analysis and determination of bio molecules in the body fluids

.**Mapping of course outcomes with program outcomes**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2			3		1		1	1	1	3
CO2	3			2		1		1		1	3
CO3	3			2		2	3	1			2
CO4	2			3		1	2	1			3
CO5	3			1		2			1		3
CO6	2			1		2	1	1	1		3

Mapping of Course Outcomes with Progra

CO/PSO	PSO1	PSO2
CO1	1	1
CO2	1	2
CO3	2	2
CO4	2	2
CO5	2	2
CO6	1	2

Lecture wise Programme: **3 Hrs/Week**

1. Introduction to biochemistry:

Cell and its biochemical organization, transport process across the cell membranes. Energy rich compounds; ATP, Cyclic AMP and their biological significance.

2. Enzymes: Definition; Nomenclature; IUB classification; Factor affecting enzyme activity; Enzyme action; enzyme inhibition. Isoenzymes and their therapeutic and diagnostic applications; Coenzymes and their biochemical role and deficiency diseases.

3. Carbohydrate metabolism: Glycolysis, Citric acid cycle (TCA cycle), HMP shunt, Glycogenolysis, gluconeogenesis, glycogenesis. Metabolic disorders of carbohydrate metabolism (diabetes mellitus and glycogen storage diseases); Glucose, Galactose tolerance test and their significance; hormonal regulation of carbohydrate metabolism.

4. Lipid metabolism: Oxidation of saturated (β-oxidation); Ketogenesis and ketolysis; biosynthesis of fatty acids, lipids; metabolism of cholesterol; Hormonal regulation of lipid metabolism. Defective metabolism of lipids (Atheroslerosis, fatty liver, hypercholesterolmiea).

5. Biological oxidation: Coenzyme system involved in Biological oxidation. Electron transport chain (its mechanism in energy capture; regulation and inhibition); Uncouplers of ETC; Oxidative phosphorylation;

6. Protein and amino acid metabolism: Protein turn over; nitrogen balance; Catabolism of Amino acids (Transamination, deamination & decarboxylation). Urea cycle and its metabolic disorders; production of bile pigments; hyperbilirubinemia, porphoria, jaundice. Metabolic disorder of Amino acids.

7. Nucleic acid metabolism: Metabolism of purine and pyrimidine nucleotides; Protein synthesis; Genetic code; inhibition of protein synthesis; mutation and repair mechanism; DNA replication (semiconservative /onion peel models) and DNA repair mechanism.

8. Introduction to clinical chemistry: Cell; composition; malfunction; Roll of the clinical chemistry laboratory.

9. The kidney function tests: Role of kidney; Laboratory tests for normal function includes-

a) Urine analysis (macroscopic and physical examination, quantitative and semiquantitative tests.)

b) Test for NPN constituents. (Creatinine /urea clearance, determination of blood and urine creatinine, urea and uric acid)

c) Urine concentration test

d) Urinary tract calculi. (stones)

10. Liver function tests: Physiological role of liver, metabolic, storage, excretory, protective, circulatory functions and function in blood coagulation. a) Test for hepatic dysfunction-Bile pigments metabolism. b) Test for hepatic function test- Serum bilirubin, urine bilirubin, and urine urobilinogen. c) Dye tests of excretory function. d) Tests based upon abnormalities of serum proteins. Selected enzyme tests.

11. Lipid profile tests: Lipoproteins, composition, functions. Determination of serum lipids, total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides.

12. Immunochemical techniques: for determination of hormone levels and protein levels in serum for endocrine diseases and infectious diseases. Radio immuno assay (RIA) and Enzyme Linked Immuno Sorbent Assay (ELISA)

13. Electrolytes: Body water, compartments, water balance, and electrolyte distrubution. Determination of sodium, calcium potassium, chlorides, bicarbonates in the body fluids.

Text books:

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.

References:

1. Biochemistry by Stryer.
2. Biochemistry by D. Satyanarayan and U.Chakrapani
3. Textbook of Biochemistry by Rama Rao.

Web Resources:

W1.https://pmc.ncbi.nlm.nih.gov/articles/PMC77

78149/

W2.https://courses.lumenlearning.com/suny-ap2/chapter/protein-metabolism/

W3.https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/lipid-

metabolism

W4.https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Chemistry_for_Allied_Health_(Soult)/15%3A_Metabolic_Cycles/15.02%3A_The_Citric_Acid_Cycle

W5.https://allen.in/neet/biology/hmp-shunt

MEDICINAL BIOCHEMISTRY-PRACTICAL

Course code: 2516PY09

Course objectives: On completion of this course the student will able to

COB 1: understand the catalytic activity of enzymes and importance of isoenzymes in diagnosis of diseases

COB 2: know the metabolic process of biomolecules in health and illness (metabolic disorders)

COB 3: understand the genetic organization of the mammalian genome; protein synthesis; replication; mutation and repair mechanism.

COB 4: know the biochemical principles of organ function tests of kidney, liver and endocrine gland

COB 5: understand how to perform qualitative analysis and determination of biomolecules in the body fluids

Course outcome: At the end of the course, the student will be able to:

CO1: Determine the Qualitative analysis of normal and abnormal constituents of urine.

CO2: Categories the urine creatinine by Jaffe's method and calcium by precipitation method.

CO3: Assess the blood sugar by Folin-Wu tube method

CO4: Identification of SGOT and SGPT in

serum. **CO5:** Estimation of Urea, Proteins and

serum bilirubin **CO6:** Predict sodium, calcium

and potassium in serum **Mapping of course**

outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2			1		2	2	2	1	2	1
CO2	2			2		1	2	3	2	1	3
CO3				2		2	3	2	3	2	3
CO4	2			3		2	2	2	2	3	2
CO5	2			2	1	2	2	2	2	2	2
CO6	3			2		1	2	1	1	2	3

Mapping of Course Outcomes with Program-Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	2
CO3	2	2
CO4	2	2
CO5	2	2
CO6	3	2

Lecture wise Programme: **3 Hrs/Week**

List of Experiments:

Expt. No	Title	CO
1.	Qualitative analysis of normal constituents of urine.	**CO1**
2.	Qualitative analysis of abnormal constituents of urine.	**CO1**
3.	Quantitative estimation of urine sugar by Benedict's reagent method.	**CO2**
4.	Quantitative estimation of urine chlorides by Volhard's method.	**CO2**
5.	Quantitative estimation of urine creatinine by Jaffe's method.	**CO2**
6.	Quantitative estimation of urine calcium by precipitation method.	**CO2**
7.	Quantitative estimation of serum cholesterol by Libermann Burchard's method.	**CO2**
8.	Quantitative estimation of blood creatinine.	**CO2**
9.	Quantitative estimation of blood sugar Folin-Wu tube method.	**CO2**
10.	Preparation of Folin Wu filtrate from blood.	**CO3**
11.	Estimation of SGOT in serum.	**CO4**
12.	Estimation of SGPT in serum.	**CO4**
13.	Estimation of Urea in Serum.	**CO4**
14.	Estimation of Proteins in Serum.	**CO4**
15.	Determination of serum bilirubin.	**CO4**
16.	Determination of Glucose by means of Glucoseoxidase.	**CO4**
17.	Enzymatic hydrolysis of Glycogen/Starch by Amylases.	**CO5**
18.	Study of factors affecting Enzyme activity. (pH & Temp.)	**CO6**
19.	Preparation of standard buffer solutions and its pH measurements (any two)	**CO3**
20.	Experiment on lipid profile tests	**CO6**
21.	Determination of sodium, calcium and potassium in serum.	**CO4**

Text Books:

1. Textbook of Biochemistry by Deb.
2. Outlines of Biochemistry by Conn and Stumpf

Reference Books:

1. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
2. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
3. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.

Web Links:

W1. https://www.sciencedirect.com/science/article/pii/S0021925818769160

W2. https://www.sciencedirect.com/science/article/pii/S0021925818859427

W3. https://jamanetwork.com/journals/jamainternalmedicinG/article-abstract/653339

W4. https://link.springer.com/article/10.1007/BF01217998

W5. https://www.sciencedirect.com/science/article/abs/pii/S073170851831450X

PHARMACEUTICAL ORGANIC CHEMISTRY (Theory)

Subject Code : 2516PY04

Course Objectives: Upon completion of course, student shall be able to

COB1: Understand the IUPAC/Common system of nomenclature of simple organic compounds belonging to different classes of organic compounds.

COB2: Understand the Free radical substitution, addition, elimination, and oxidation reduction reactions with mechanism, orientation of the reaction, order of reactivity, stability of compounds

COB3: Knowledge on named organic reactions with mechanisms methods of preparation, test for purity, principle involved in the assay, important medicinal uses of some important organic compounds

Course Outcomes: At the end of the course, the student will be able to:

CO1: Assess the Physicochemical properties of molecules like Melting point, boiling point

CO2: Justify Free radicals chain reactions of alkane and Alicyclic compounds

CO3: Summarize substitution, addition, elimination, Reactions of

mole **CO4**: Explain theory of resonance and Named reactions with

mechanism **CO5:** Determine Oxidation reduction reaction.

CO6: Illustrate the following official compounds- preparation, test for purity, assay and medicinal uses of Chlorobutanol

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1			2	1		2		2		1	2
CO2	1			2		2		1	2	2	
CO3	1		2			2		2		1	2
CO4	1		2			2		2		1	2
CO5	1		2			2	1	2	2	1	2
CO6	1		2	1		2	1	2		1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	3	1
CO5	2	1
CO6	2	1

Lecture wise Programme: **3 Hrs/Week**

1. **Structures and Physical properties:** a. Polarity of bonds, polarity of molecules, M.P, Inter molecular forces, B.P, Solubility, non ionic solutes and ionic solutes, protic and aprotic Solvents, ion pairs, b. Acids and bases, Lowry bronsted and Lewis theories c. Isomerism

2. Nomenclature of organic compound belonging to the following classes Alkanes, Alkenes, Dienes, Alkynes, Alcohols, Aldehydes, Ketones, Amides, Amines, Phenols, Alkyl Halides, Carboxylic Acid, Esters, Acid Chlorides And Cycloalkanes.

3. **Free radicals chain reactions of alkane :** Mechanism, relative reactivity and stability

4. **Alicyclic compounds:** Preparations of cyclo alkanes, Bayer strain theory and orbital picture of angle strain.

5. **Nucleophilic aliphatic substitution mechanism:** Nucleophiles and leaving groups, kinetics of second and first order reaction, mechanism and kinetics of SN2 reactions. Stereochemistry and steric hindrance, role of solvents, phase transfer catalysis, mechanism and kinetics of SN1 reactions, stereochemistry, carbocation and their stability, rearrangement of carbocation, role of solvents in SN1 reaction, Ion dipole bonds, SN2 versus SN1 solvolyses, nucleophilic assistance by the solvents.

6. **Dehydro halogenation of alkyl halides:** 1,2 elimination, kinetics, E2 and E1 mechanism, elimination via carbocation, evidence for E2 mechanism, absence of rearrangement isotope effect, absence hydrogen exchange, the element effect, orientation and reactivity, E2 versus E1, elimination versus substitution, dehydration of alcohol, ease of dehydration, acid catalysis, reversibility, orientation.

7. **Electrophillic and free radicals addition:** Reactions at carbon-carbon, double bond, electrophile, hydrogenation, heat of hydrogenation and stability of alkenes, markownikoff rule, addition of hydrogen halides, addition of hydrogen bromides,

8. peroxide effect, electrophillic addition, mechanism, rearrangement, absence of hydrogen exchange, orientation and reactivity, addition of halogen, mechanism, halohydin formation, mechanism of free radicals additon, mechanism of peroxide initiated addition of hydrogen bromide, orientation of free addition, additions of carbene to alkene, cyclo addition reactions.

9. **Carbon-carbon double bond as substituents:** Free radical halogenations of alkenes, comparision of free radical substitution with free radical addition, free radical substitution in alkenes, orientation and reactivity, allylic rearrangements.

10. **Theory of resonance:** Allyl radical as a resonance hybrid, stability, orbital picture, resonance stabilisation of allyl radicals, hyper conjugation, allyl cation as a resonance hybrid, nucleophillic substitution in allylic substrate, SN1 reactivity, allylic rearrangement, resonance stabilisation of allyl cation, hyper conjugation, nucleophilic substitution in allylic substrate, SN2 nucleophilic substituion in vinylic substrate, vinylic cation, stability of conjugated dienes, resonance in alkenes, hyper conjugation, ease of formation of conjugated dienes, orientation of elimination, electrophilic addition to conjugated dienes, 1,4- addition, 1,2-versus 1,4-addition, rate versus equilibrium, orientation and reactivity of free radical addition to conjugated dienes.

11. **Elecrophilic aromatic substitution:** Effect of substituent groups, determination of orientation, determination of relative reactivity, classification of substituent group, mechanism of nitration, sulphonation, halogenation, friedel craft alkylation, friedel craft acylation, reactivity and orientation, activating and deactivating O,P,M directing groups, electron release via resonance, effect of halogen on electrophilic aromatic substitution in alkyl benzene, side chain halogination of alkyl benzene, resonance stabilization of benzyl radical.

12. **Nucleophilic addition reaction:** Mechanism, ionisation of carboxylic acids, acidity constants, acidity of acids, structure of carboxylate ions, effect of substituent on acidity, nucleophilic acyl substitution reaction, conversion of acid-to-acid chloride, esters, amide and anhydride. Role of caboxyl group, comparison of alkyl nucleophilic substitution with acyl nucleophilic substitution.

13. Mechanism of aldol condensation, claisen condensation, cannizzaro reaction, crossed aldol condensation, crossed cannizzaro reaction, benzoin condensation, perkin condensation. Knoevenagel, Reformatsky reaction, Wittig reaction, Michael addition.

14. **Hoffman rearrangement:** Migration to electron deficient nitrogen, Sandmeyer's reaction, basicity of amines, diazotisation and coupling, acidity of phenols, Williamson synthesis, Fries rearrangement, Kolbe reaction, Reimer tieman's reactions.

15. **Nucleophilic aromatic substitution:** Bimolecular displacement mechanisms, orientation, comparison of aliphatic nucleophilic substitution with that of aromatic.

16. Oxidation reduction reaction.

17. Study of the following official compounds- preparation, test for purity, assay and medicinal uses of Chlorbutol, Dimercaprol, Glyceryl trinitrate, Urea, Ethylene diamine dihyrate, Vanillin, Paraldehyde, Ethylene chloride, Lactic acid, Tartaric acid, citric acid, salicylic acid, aspirin, methyl salicylate, ethyl benzoate, benzyl benzoate, dimethyl pthalate, sodium lauryl sulphate, saccharin sodium, mephensin

Text Books:

1. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
2. Organic Chemistry by P.L. Soni

Reference Books:

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar, Volume-I
3. Pharmaceutical orgonic chemistry by Dr. B. Shiva Kumar

Web Links:

W1: Pharmaceutical Organic Chemistry - PHARMD GURU

W2: https://www.lastbenchpharmacist.in/post/pharm-d-1st-year-organic-chemistry

W3: https://pharmdbm.com/pharmaceutical-organic-chemistry

W4: https://www.pharmdinfo.com/

W5: https://www.thepharmacystudy.com/

PHARMACEUTICAL ORGANIC CHEMISTRY (Practical)

Course Code: 2516PY10

Course objectives: Upon completion of course student shell able to

COB1: Understand the IUPAC/Common system of nomenclature of simple organic compounds belonging to different classes of organic compounds.

COB2: Understand the Free radical substitution, addition, elimination, and oxidation reduction reactions with mechanism, orientation of the reaction, order of reactivity, stability of compounds

COB3: Knowledge on named organic reactions with mechanisms methods of preparation, test for purity, principle involved in the assay, important medicinal uses of some important organic compounds.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Determine the sources of impurities and methods to determine the impurities in inorganic formulations.

CO2: Justify the medicinal and pharmaceutical importance of inorganic compounds, drugs and pharmaceuticals

CO3: Differentiate physiological ions.

CO4: Categorize inorganic pharmaceuticals as gastrointestinal agents

CO5: Explain the importance of inorganics as a anti dotes

CO6: Support the importance of radiopharmaceuticals in medicines.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2		2	2	2			3
CO2	3	2	2	2		2	2	2			2
CO3	3	3	2	2		2	2	2			2
CO4	3		2	2			2	2			1
CO5	3	2	2	2		2	2	2			3
CO6	3	2	2	2		2	2	2			3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	3	1
CO5	3	1
CO6	3	1

Lecture wise Programme: **3 Hrs/Week**

List of Experiments:

Expt. No	Title	CO
1.	Preparation of Acetanilde / aspirin (Acetylation)	**CO1**
2.	Preparation of Benzanilide / Phenyl benzoate (Benzoylation)	**CO1**
3.	Preparation of P-bromo acetanilide / 2,4,6 – tribromo aniline (Bromination)	**CO1**
4.	Preparation of Dibenzylidene acetone (Condensation)	**CO1**
5.	Preparation of 1-Phenylazo-2-napthol (Diazotisation and coupling)	**CO1**
6.	Preparation of Benzoic acid / salicylic acid (Hydrolysis of ester)	**CO2**
7.	Preparation of M-dinitro benzene (Nitration)	**CO2**
8.	Preparation of 9, 10 – Antharaquinone (Oxidation of anthracene) / preparation of benzoic acid from toluene or benzaldehyde	**CO2**
9.	Preparation of M-phenylenediamine (Reduction of M-dinitrobenzene) / Aniline from nitrobenzene	**CO2**
10.	Preparation of Benzophenoneoxime 11. Nitration of salicylic acid	**CO2**
11.	Preparation of Nitration of salicylic acid	**CO2**
12.	Preparation of picric acid	**CO3**
13.	Preparation of O-chlorobenzoic acid from O-chlorotolune	**CO4**
14.	Preparation of cyclohexanone from cyclohexanol	**CO5**
15.	Systematic qualitative organic analysis including preparation of derivatives Phenols, amides, carbohydrates, amines, carboxylic acids, aldehyde and ketones, Alcohols, esters, hydrocarbons, anilides, nitrocompounds.	**CO6**
16.	Introduction to the use of stereo models: Methane, Ethane, Ethylene, Acetylene, Cis alkene, Trans alkene, inversion of configuration	**CO6**

Text Books:

1. T.R.Morrison and R. Boyd - Organic chemistry
2. .L.Finer- Organic chemistry the fundamentals of chemistry

Reference Books:

1. Orgonic chemistry – Brown
2. Advanced orgonic chemistry- Jerry march, Wiley
3. Organic chemistry- Cram and Hammered

Web Links:

W1: Pharmaceutical Organic Chemistry - PHARMD GURU

W2: Pharm.D Handwritten Notes : PharmDia

W3: 1.4 Pharmaceutical Organic Chemistry Pharm D Syllabus, Notes, PDF, Books, Downloads - Pharmacy Infoline

W4: Pharmaceutical Organic Chemistry Complete Notes - RecNotes

W5: PharmD 1st Year Notes - Doctor of Pharmacy - PharmD Info

PHARMACEUTICAL INORGANIC CHEMISTRY (THEORY)

Subject Code: 2516PY05

Course Objectives: Upon completion of the course, the student shall be able to

COB1: Understand the principles and procedures of analysis of drugs and also regarding the application of inorganic pharmaceuticals.

COB2: Know the analysis of the inorganic pharmaceuticals their applications.

COB3: Appreciate the importance of inorganic pharmaceuticals in preventing and curing the disease.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Describe inorganic pharmaceutical errors and volumetric analysis and perform the acid base titrations

CO2: Demonstrate about the different types titrations and how to prepare solutions acid- base titrations, redox titrations, non aqueous titrations, complexometric titrations

CO3: Analyze the theory of indicators and gravimetry and know about the different types limit tests

CO4: Justify the different types of medicinal gasses and various preparations of acidifiers and antacids

CO5: Use of cathartics and importance of electrolyte replenishers

CO6: Design the different types of antimicrobials, pharmaceutical aids and various radio pharmaceuticals and their importance

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
CO1	3	1	2	3					3	3	3
CO2	3	1	2	2					3	2	2
CO3	3	1	2	2					2	1	2
CO4	3	2	2	2					2	3	2
CO5	3	1	2	3					3	2	2
CO6	3	1	2	3					2	3	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	3	2
CO5	3	2
CO6	3	2

Lecture wise programme: **2 Hrs/Week**

1. Errors
2. Volumetric analysis
3. Acid-base titrations
4. Redox titrations
5. Non aqueous titrations
6. Precipitation titrations
7. Complexometric titrations
8. Theory of indicators
9. Gravimetry
10. Limit tests
11. Medicinal gases
12. Acidifiers
13. Antacids
14. Cathartics
15. Electrolyte replenishers
16. Essential Trace elements
17. Antimicrobials
18. Pharmaceutical aids
19. Dental Products

20. Miscellaneous compounds

21. Radio Pharmaceuticals

Text books:

1. A text book Inorganic medicinal chemistry by Surendra N. Pandeya

2. Inorganic Pharmaceutical Chemistry III-Edition P.Gundu Rao

Reference books:

1. Inorganic Pharmaceutical Chemistry by Anand & Chetwal

2. Pharmaceutical Inorganic chemistry by Dr.B.G.Nagavi c. Analytical chemistry principles by John H. Kennedy

3. I.P.1985 and 1996, Govt. of India, Ministry of health

Web Links:

W1:https://www.researchgate.net/profile

/Nithin-R-5/publication/351343882_12_RADIOPHARMACEUTICALS/links/60922828458515d315f76259/12-RADIOPHARMACEUTICALS?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19&_cf_chl_tk=1XtGDetOjvr_iqmhJ.GrsXsh5U MEU6b2rml2BX0Wdn0-1750761133-1.0.1.1-PBwWrStLpdxgv8CfkoQK7rYiwRmJsf2USL9ftioJ0sw

W2:https://www.bing.com/search?pglt=41&q=Errors+in+inorganic+chemistry&cvid=ab7d7e40a03941ac996bc4fca3940011&gs_lcrp=EgRlZGdlKgYIABBFGDkyBggAEEUYOTIGCAEQABhAMgYIAhAAGEAyBggDEAAYQDIGCAQQABhAMgYIBRAAGEAyBggGEAAYQDIGCAcQABhAMgYICBAAGEDSAQkxMTk0MWowajGoAgiwAgE&FORM=ANNTA1&adppc=reversed&PC=W044

W3:https://www.bing.com/search?pglt=41&q=Electrolyte+replenishers+inorganic+chemistry&cvid=ec41a5b60f964ac583b09fdc2dd94472&gs_lcrp=EgRlZGdlKgYIABBFGDkyBggAEEUYOTIGCAEQABhAMgYIAhAAGEAyBggDEAAYQDIGCAQQABhAMgYIBRAAGEAyBggG

EAAYQDIGCAcQABhAMgYICBAAGEDSAQkxMzkwNmowajGoAgiwAgE&FORM=ANNTA1&adppc=reversed&PC=W044

W4: https://scienceinfo.com/gravimetric-analysis/

W5: https://www.pharmaguideline.com/2011/07/limit-tests.html

PHARMACEUTICAL INORGANIC CHEMISTRY (PRACTICAL)

Subject Code: 2516PY11

Course Objectives: Upon completion of the course, the student shall be able to

COB1: Understand the principles and procedures of analysis of drugs and also regarding the application of inorganic pharmaceuticals.

COB2: Know the analysis of the inorganic pharmaceuticals their applications.

COB3: Appreciate the importance of inorganic pharmaceuticals in preventing and curing the disease.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Demonstrate the Limit test for various Inorganic compounds

CO2: Determine the purity of the inorganic compounds

CO3: Characterize inorganic compounds

CO4: Identify the Inorganic pharmaceuticals.

CO5: Justify the purity of Inorganic compounds.

CO6: Prepare Inorganic compounds.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3			2			3				
CO2	3	3	3		3	2	3	3	3		3
CO3	3	3	3		3	2	3	3	3		3
CO4	3	1	3	3	1	2	3	1	1		
CO5	3	1	2		1		3	2			2
CO6	3	1	2		1		3	2			2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	1
CO3	3	1
CO4	2	3
CO5	3	1
CO6	3	1

Lecture wise Programme: **3 Hrs/Week**

List of Experiments:

S.NO	TITLE	CO
1.	Limit test for Chlorides	**CO1**
2.	Limit test for Sulphates	**CO1**
3.	Limit test for Iron	**CO1**
4.	Limit test for Heavy metals	**CO1**
5.	Limit test for Arsenic	**CO1**
6.	Modified Limit test for Chlorides & Sulphates	**CO1**
7.	Ammonium chloride- Acid-base titration	**CO2**
8.	Ferrous sulphate- Cerimetry	**CO2**
9.	Copper sulpahte- Iodometry	**CO2**
10.	Calcilugluconate- Complexometry	**CO2**
11.	Hydrogen peroxide – Permanganometry	**CO2**
12.	Sodium benzoate – Nonaqueous titration	**CO2**
13.	Sodium chloride – Modified volhard's method	**CO2**
14.	Assay of KI – KIO3 titration	**CO2**
15.	Assay Gravimetric estimation of barium as barium sulphate	**CO2**
16.	Assay Sodium antimony gluconate or antimony potassium tartarate	**CO2**
17.	Estimation of Sodium hydroxide and sodium carbonate	**CO3**
18.	Estimation of Boric acid and Borax	**CO3**
19.	Estimation Oxalic acid and sodium oxalate	**CO3**
20.	Sodium bicorbonate b. Barium sulphate c. Ferrous sulphate d. Potassium chloride	**CO4**
21.	Identification of Barium sulphate	**CO4**
22.	Identification of Ferrous sulphate	**CO4**
23.	Identification of Potassium chloride	**CO4**
24.	Swelling power in Bentonite	**CO5**
25.	Acid neutralising capacity in aluminium hydroxide gel	**CO5**
26.	Ammonium salts in potash alum	**CO5**
27.	Adsorption power heavy Kaolin	**CO5**
28.	Presence of Iodates in KI	**CO5**
29.	Preparation of Boric acids	**CO6**
30.	Preparation of Potash alum	**CO6**
31.	Preparation of Calcium lactate	**CO6**

Text books:

1. A text book Inorganic medicinal chemistry by Surendra N. Pandeya

2. Inorganic Pharmaceutical Chemistry III-Edition P.Gundu Rao

3. A. H. Beckett and J. B. Stanlake's Practical Pharmaceutical chemistry Vol-I & Vol-II c. Inorganic

Reference books:

1. Inorganic Pharmaceutical Chemistry by Anand & Chetwal

2. Pharmaceutical Inorganic chemistry by Dr.B.G.Nagavi c. Analytical chemistry principles by John H. Kennedy 3. I.P.1985 and 1996, Govt. of India, Ministry of health

Web Links:

W1: https://www.pharmaguideline.com/2011/07/limit-tests.html

W2: https://www.scribd.com/document/690979838/Preparation-of-Potash-Alum

W3: https://www.firsthope.co.in/estimation-of-calcium-gluconate

W4: https://www.titrations.info/permanganate-titration-hydrogen-peroxide

W5: https://www.pharmaguideline.com/2021/10/mohrs-method-volhards-method-modified- volhards-method-fajans-method.html

W6: https://www.scribd.com/document/718189565/SWELLING-POWER-IN-BENTONITE

REMEDIALMATHEMATICS

COURSE CODE: 2516PY49

COURSE OBJECTIVES: Upon completion of the course, the student shall be able to

COB1: Know Trigonometry, Analytical geometry, Matrices, Determinant, Integration, Differential equation, Laplace transform and their applications

COB2: Solve the problems of different types by applying theory

COB3: Appreciate the important applications of mathematics in pharmacy

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: Apply mathematical concepts and principles to perform computations for Pharmaceutical Sciences.

CO2: Create, use and analyze mathematical representations and mathematical relationships.

CO3: Communicate mathematical knowledge and understanding to help in the field of Clinical Pharmacy.

CO4: Perform abstract mathematical reasoning.

CO5: Apply the techniques like integral calculus and differentiation to analyze complex problem in pharmacokinetics and in the field of clinical pharmacy

CO6: Analyze the dependent process such as controlled drug delivery and reaction kinetics by laplace transformation techniques

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3			2		2	3	3	1	1	3
CO2	3			2		2	3	3	1	1	3
CO3	3			2		2	3	3	1	1	3
CO4	3			2		2	3	3	1	1	3
CO5	3			2		2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	2
CO3	1	3
CO4	1	2
CO5	2	3
CO6	2	3

Lecture wise Programme: **3Hrs/ Week**

1. **Algebra** : Determinants, Matrices
2. **Trigonometry :** Sides and angles of a triangle, solution of triangles
3. **Analytical Geometry** :Points, Straight line, circle, parabola
4. **Differential calculus**: Limit of a function, Differential calculus, Differentiation of a sum, Product, Quotient Composite, Parametric, exponential, trigonometric and Logarithmic function. Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions of two variables
5. **Integral Calculus**: Definite integrals, integration by substitution and by parts, Properties of definite integrals.
6. **Differential equations:** Definition, order, degree, variable separable, homogeneous, Linear, heterogeneous, linear, differential equation with constant coefficient, simultaneous linear equation of second order.
7. **Laplace transform**: Definition, Laplace transform of elementary functions, Properties of linearity and shifting.

Text books

1. Differential calculus By Shantinarayan
2. Text book of Mathematics for second year pre-university by Prof.B.M.Sreenivas

Reference books

1. Integral calculus By Shanthinaraya
2. Engineering mathematics By B.S.Grewal
3. Trigonometry Part-I By S.L.Loney

Website Links:
W1: https://allen.in/jee/maths/determinants-and-matrices
W2: https://testbook.com/electrical-engineering/definition-and-properties-of-laplace-transform W3: https://www.cuemath.com/geometry/analytical-geometry/
W4: https://tutorial.math.lamar.edu/classes/calcii/integrationbyparts.aspx

REMEDIAL BIOLOGY (Theory)

Subject Code: 2516PY06

Course Objectives: Upon completion of the course, the student shall be able to:
COB1: Explain the historical development and significance of natural drugs in pharmacy.
COB2: Identify various natural sources of drugs in plant and animal origin.
COB3: Classify natural drugs based on source, morphology, and taxonomy.
COB4: Describe the distribution and occurrence of medicinal plants and animal-derived substances.
COB5: Recognize the role of natural sources in the development of Pharmacognosy.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Define the scope and importance of studying biology in the pharmacy curriculum.
CO2: Describe the origin and history of naturally occurring drugs.
CO3: Identify drugs obtained from various plant parts such as roots, stems, leaves, flowers, and fruits.
CO4: Classify animal-derived drugs and explain their biological sources.
CO5: Discuss the characteristics and medicinal relevance of selected plants and animals.
CO6: Illustrate the significance of natural sources in the evolution of Pharmacognosy.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3			2		2	3	3	1	1	3
CO2	3			2		2	3	3	1	1	3
CO3	3			2		2	3	3	1	1	3
CO4	3			2		2	3	3	1	1	3
CO5	3			2		2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	
CO2	1	
CO3	1	
CO4	1	
CO5	1	
CO6	1	

Lecture wise Programme **3 Hrs. / Week**

PART-A

1. Introduction
2. General organization of plants and its inclusions
3. Plant tissues
4. Plant kingdom and its classification
5. Morphology of plants
6. Root, Stem, Leaf and Its modifications
7. Inflorescence and Pollination of flowers
8. Morphology of fruits and seeds
9. Plant physiology
10. Taxonomy of Leguminosae, umbelliferae, Solanaceae, Lilliaceae, Zinziberaceae, Rubiaceae
11. Study of Fungi, Yeast, Penicillin and Bacteria

PART-B

1. Study of Animal cell
2. Study animal tissues
3. Detailed study of frog
4. Study of Pisces, Raptiles, Aves
5. Genearal organization of mammals
6. Study of poisonous animals

Text Books:

1. Text book of Biology by S.B.Gokhale

2. A Text book of Biology by Dr.Thulajappa and Dr. Seetaram.

Reference Books:

1. A Text book of Biology by B.V.Sreenivasa Naidu
2. A Text book of Biology by Naidu and Murthy
3. 3.Botany for Degree students By A.C.Dutta.

Web Links:

W1: https://pmc.ncbi.nlm.nih.gov/articles/PMC123731/

W2: https://www.geeksforgeeks.org/biology/solanaceae-fabaceae-liliaceae/

W3: https://open.lib.umn.edu/horticulture/chapter/8-1-fruit-morphology/

W4: https://bio.libretexts.org/Courses/Cosumnes_River_College/Contemporary_Biology_(Apteka r)/ 10%3A_Diver _Protists_Fungi_Plants_and_Animals/10.03%3A_The_Plant_Kingdom_(Kingdom_Plantae)

W5: https://www.britannica.com/animal/mammal

REMEDIAL BIOLOGY-PRACTICAL

Course code: 2516PY12

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

COB 1: Understand the catalytic activity of enzymes and the importance of isoenzymes in the diagnosis of diseases.

COB 2: Know the metabolic processes of biomolecules in health and illness (metabolic disorders).

COB 3: Understand the genetic organization of the mammalian genome, including protein synthesis, replication, mutation, and repair mechanisms.

COB 4: Know the biochemical principles of organ function tests for the kidney, liver, and endocrine glands.

COB 5: Understand how to perform qualitative analysis and determination of biomolecules in body fluids.

Course outcome: At the end of the course, the student will be able to:

CO1: Determine the qualitative analysis of normal and abnormal constituents of urine.

CO2: Categorize urine creatinine using Jaffe's method and calcium using the precipitation method.

CO3: Assess blood sugar levels using the Folin-Wu tube method.

CO4: Identify SGOT and SGPT enzymes in serum.

CO5: Estimate urea, proteins, and serum bilirubin levels.

CO6: Predict sodium, calcium, and potassium levels in serum.

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2			1		2	2	2	1	2	1
CO2	2			2		1	2	3	2	1	3
CO3				2		2	3	2	3	2	3
CO4	2			3		2	2	2	2	3	2
CO5	2			2	1	2	2	2	2	2	2
CO6	3			2	1	1	2	1	1	2	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	
CO2	1	
CO3	1	
CO4	1	
CO5	1	
CO6	1	

Lecture wise Programme: **3 Hrs/Week**

List of Experiments:

Expt. No	Title	CO
1	Introduction of biology experiments	**CO1**
2	Study of cell wall constituents and cell inclusions	**CO1**
3	Study of Stem modifications	**CO2**
4	Study of Root modifications	**CO2**
5	Study of Leaf modifications	**CO2**
6	Identification of Fruits and seeds	**CO2**
7	Preparation of Permanent slides	**CO2**
8	T.S. of Senna, Cassia, Ephedra, Podophyllum.	**CO2**
9	Simple plant physiological experiments	**CO2**
10	Identification of animals	**CO3**
11	Detailed study of Frog	**CO4**
12	Computer based tutorials	**CO4**

Text Books:

1. Text book of Biology by S. B. Gokhale
2. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.

Reference Books:

1. A Text book of Biology by B. V. Sreenivasa Naidu
2. A Text book of Biology by Naidu and Murthy
3. Botany for Degree students By A. C. Dutta.

Web Links:

W1: https://pmc.ncbi.nlm.nih.gov/articles/PMC123731/

W2: https://www.geeksforgeeks.org/biology/solanaceae-fabaceae-liliaceae/

W3: https://open.lib.umn.edu/horticulture/chapter/8-1-fruit-morphology/

W4: https://bio.libretexts.org/Bookshelves/Botany/Botany_(Ha_Morrow_and_Algiers)/03%3A_Plant_Structure/3.04%3A_Leaves/3.4.03%3A_Leaf_Modifications

2nd YEAR

PATHOPHYSIOLOGY-THEORY

Subject code: 2516PY13
Course Objectives: Upon completion of the subject student shall be able to –

COB 1: describe the etiology and pathogenesis of the selected disease states;

COB2: name the signs and symptoms of the diseases; and

COB3; mention the complications of the diseases.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Understand basic principles of cell injury
CO2. Understand about inflammation and repair of wounds

CO3: Gain knowledge on immunity and hypersensitivity

CO4: Understand about cancer and the type of tumours

CO5: Differentiate shock and various radiation diseases

CO6: Relevant pathophysiology of parkinsonism, schizophrenia, depression, hypertension and other common conditions.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	1	2	2	1	2	2	1	2
CO2	3	1	2	1	2	2	1	2	2	1	2
CO3	3	1	2	1	2	2	1	2	2	1	2
CO4	3	1	2	1	2	2	1	2	2	1	2
CO5	3	1	2	1	2	2	1	2	2	1	2
CO6	3	1	2	1	2	2	1	2	2	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	3
CO2	2	2
CO3	3	2
CO4	2	2
CO5	3	3
CO6	3	3

Lecture wise Programme: **3 Hrs/Week**

1 Basic principles of cell injury and Adaptation

a. Causes, Pathogenesis and morphology of cell injury

b. b) Abnormalities in lipoproteinaemia, glycogen infiltration and glycogen infiltration and glycogen infiltration and glycogen storage diseases

2 Inflammation

a. Pathogenesis of acute inflammation, Chemical mediators in inflammation, Types of chronic inflammation

b. Repairs of wounds in the skin, factors influencing healing of wounds

3 Diseases of Immunity

a) Introduction to Tand B cells

b) MHC proteins or transplantation antigens

c) Immune tolerance - Hypersensitivity Hypersensitivity type I, II, III, IV, Biological significance, Allergy due to food, chemicals and drugs - Autoimmunity Criteria for autoimmunity, Classifications of autoimmune diseases in man, mechanism of autoimmunity, Transplantation and immunologic tolerance, allograft rejections, transplantation antigens, mechanism of rejection of allograft. - Acquired immune deficiency syndrome (AIDS),amylodosis

4 Cancer:

Differences between benign and malignant tumors, Histological diagnosis of malignancy, invasions and metastasis, patterns of spread, disturbances of growth of cells, classification of tumors, general biology of tumors, spread of malignant tumors, etiology and pathogenesis of cancer

5 Types of shock, mechanisms, stages and management

6 Biological effects of radiation

7 Environmental and nutritional diseases

i) Air pollution and smoking- SO2,NO, NO2, and CO

ii) Protein calorie malnutrition, vitamins, obesity, pathogenesis of starvation.

8 Pathophysiology of common diseases

a. Parkinsonism

b. Schizophrenia

c. Depression and mania

d. Hypertension,

e. Stroke (ischaemic and hemorrhage)

f. Angina, CCF, Atherosclerosis, Myocardial infarction

g. Diabetes Mellitus

h. Peptic ulcer and inflammatory bowel diseases

i. Cirrhosis and Alcoholic liver diseases

j. Acute and chronic renal failure

k. Asthma and chronic obstructive airway diseases

9 Infectious diseases :

Sexually transmitted diseases (HIV,Syphilis,Gonorrhea), Urinary tract infections, Pneumonia, Typhoid, Tuberculosis, Leprosy, Malaria Dysentery (bacterial and amoebic), Hepatitis-infective hepatitis.

Text Books:

T1. Pathologic basis of disease by- Cotran, Kumar, Robbins.

T2. Text book of Pathology- Harsh Mohan

Reference books:

a. Clinical Pharmacy and Therapeutics; Second edition; Roger Walker; Churchill Livingstone publication

Web links:

W1: https://my.clevelandclinic.org/health/diseases/12194-cancer

W2: https://www.webmd.com/arthritis/about-inflammation

W3: https://www.slideshare.net/slideshow/biological-effects-of-radiation-132402641/132402641

W4: https://www.mayoclinic.org/diseases-conditions/parkinsons-disease/symptoms-causes/syc-20376055

W5: https://www.msdmanuals.com/home/hormonal-and-metabolic-disorders/diabetes-mellitus-dm-and-disorders-of-blood-sugar-metabolism/diabetes-mellitus-dm

PHARMACEUTICAL MICROBIOLOGY THEORY

Subject Code : 2516PY14

Course Objectives: Upon completion of the course, the student shall be able to

COB1: To understand the fundamentals of microbiology, classification of microbes, and their relationships

COB2: To apply laboratory methods for microbial identification, staining, sterilization, and disinfectant use.

COB3: To recognize mechanisms of disease transmission, toxins, and principles of immunology and immunity.

COB4: To recognize mechanisms of disease transmission, toxins, and principles of immunology and immunity.

COB5: To perform diagnostic tests and microbiological assays for identification and standardization.

COB6: To analyse infectious diseases, their symptoms, treatment, and microbial motility and behaviour.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Explain the scope, classification, and major divisions of the microbial world.

CO2: Demonstrate methods for microbial growth, nutrition, cultivation, and culture maintenance.

CO3: Apply techniques for microbial identification, staining, sterilization, and evaluation of disinfectants.

CO4: Analyse mechanisms of microbial pathogenicity, toxins, and host immune responses.

CO5: Perform diagnostic tests and microbiological assays for detection and standardization purposes.

CO6: Evaluate infectious diseases in terms of transmission, symptoms, treatment, and microbial behaviour.

Mapping of Course Outcomes with Program Outcomes:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	2	1	1	1	1	1	2	1
CO2	3	3	2	2	2	1	1	1	1	2	1
CO3	3	3	3	2	2	2	1	1	2	2	1
CO4	3	2	2	2	1	3	2	2	2	3	2
CO5	3	3	3	2	2	3	1	2	2	3	2
CO6	3	2	2	3	2	3	2	2	3	3	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/ PSO	PSO1	PSO2
CO1	3	1
CO2	3	2
CO3	2	3
CO4	1	3
CO5	2	3
CO6	3	2

Lecture wise Programme: **3 Hrs/Week**

1. Introduction to the science of microbiology. Major divisions of microbial world and Relationship among them.

2. Different methods of classification of microbes and study of Bacteria, Fungi, virus, Rickettsiae, Spirochetes.

3. Nutritional requirements, growth and cultivation of bacteria and virus. Study of different important media required for the growth of aerobic and anaerobic bacteria & fungi. Differential media, enriched media and selective media, maintenance of lab cultures.

4. Different methods used in isolation and identification of bacteria with emphasis to different staining techniques and biochemical reactions. Counting of bacteria -Total and Viable counting techniques.

5. Detailed study of different methods of sterilization including their merits and demerits. Sterilization methods for all pharmaceutical products. Detailed study of sterility testing of different pharmaceutical preparations . Brief information on Validation.

6. Disinfectants- Study of disinfectants, antiseptics, fungicidal and virucidal agents factors affecting their activation and mechanism of action. Evaluation of bactericidal, bacteristatic, , virucidal activities, evaluation of preservatives in pharmaceutical preparations.

7. Immunology- Immunity, Definition, Classification, General principles of natural immunity, Phagocytosis, acquired immunity(active and passive) . Antigens, chemical nature of antigens structure and formation of Antibodies, Antigen-Antibody reactions. Bacterial exotoxins and endotoxins. Significance of toxoids in active immunity, Immunization programme, and importance of booster dose.

8. Diagnostic tests : Schick's Test, Elisa test, Western Blot test, Southern Blot PCR Widal, QBC, Mantaux Peripheral smear. Study of malarial parasite.

9. Microbial culture sensitivity Testing: Interpretation of results Principles and methods of different microbiological assays, microbiological assay of Penicillin, Streptomycin and vitamin B2 and B12. Standardisation of vaccines and sera.

10. Study of infectious diseases: Typhoid, Tuberculosis, Malaria, Cholera, Hepatitis, Meningitis, Syphilis & Gonorrhea and HIV.

Text Books:

1. Pharmaceutical Microbiology, by William B. Hugo and Anthony D. Russell, Blackwell Science.
2. Microbiology: An Introduction, by Gerard J. Tortora, Berdell R. Funke, and Christine L. Case, Pearson Education.

Reference Books:

1. Willey, J.M., Sherwood, L.M., & Woolverton, C.J. Prescott's Microbiology. McGraw-Hill Education.
2. Murray, P.R., Rosenthal, K.S., & Pfaller, M.A. Medical Microbiology. Elsevier.

Web Links:

W1: https://faculty.uobasrah.edu.iq/uploads/teaching/1631077667.pdf
W2: https://ijrpr.com/uploads/V4ISSUE11/IJRPR19086.pdf
W3: https://slidetodoc.com/diagnostic-tests-schicks-test-elisa-test-western-blot/
W4: https://www.ncbi.nlm.nih.gov/sites/books/NBK574540/
W5:https://nios.ac.in/media/documents/SecHmscicour/english/Home%20Science%20(Eng)%20 Ch-8.pdf

PHARMACEUTICAL MICROBIOLOGY (PRACTICAL)

Subject Code: 2516PY19

Course Objectives: Upon completion of the course, the student shall be able to

C**OB1:** Gain Practical Skills in aseptic technique

COB2: Master the Fundamental microbiological techniques

COB3: Develop the Competency in Sterility Testing

COB4: Apply biochemical tests for Microbial Identification

COB5: Perform antimicrobial sensitivity and microbiological assays

COB6: Demonstrate diagnostic tests for common infectious diseases

Course Outcomes: At the end of the course, the student will be able to:

CO1: Study the apparatus used in microbiology & preparation, sterilization of glassware and media

CO2: Study different staining techniques, motility characters, enumeration of microorganisms, method of isolation of pure culture, and biochemical testing for the identification of microorganisms.

CO3: Perform culture sensitivity testing, sterility testing for powder & liquid, and determination of MIC

CO4: Perform microbiological assay of antibiotics, vitamins and determination of RWC, Widal, Malaria parasite

CO5: Analyze the microbial contamination in pharmaceutical products through tests like microbial limit testing, preservative efficacy testing, and endotoxin testing **.**

CO6: Design and implement quality control protocols for aseptic processing and validate sterilization techniques in compliance with regulatory standard**.**

Mapping of Course Outcomes with Program Outcomes:

CO/P O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	1	2	1	1	1	1	1	2	1
CO2	3	3	2	2	2	1	1	1	1	2	1
CO3	3	3	3	2	2	2	1	1	2	2	1
CO4	3	2	2	2	1	3	2	2	2	3	2
CO5	3	3	3	2	2	3	1	2	2	3	2
CO6	3	2	2	3	2	3	2	2	3	3	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/ PSO	PSO1	PSO2
CO1	3	1
CO2	3	2
CO3	2	3
CO4	2	3
CO5	3	2
CO6	3	2

Lecture wise Programme: **3 Hrs/Week**

List of experiments:

Expt. No	Title	CO
1	Study of apparatus used in experimental microbiology	**CO1**
2	Sterilisation of glass wares. Preparation of media and sterilisation	**CO1**
3	Staining techniques – Simple staining; Gram's staining; Negative staining	**CO2**
4	Study of motility characters	**CO3**
5	Enumeration of micro-organisms (Total and Viable)	**CO3**
6	Study of the methods of isolation of pure culture	**CO2**
7	Biochemical testing for the identification of microorganisms	**CO2**
8	Cultural sensitivity testing for some micro-organisms	**CO3**
9	Sterility testing for powders and liquids	**CO3**
10	Determination of minimum inhibitory concentration	**CO4**
11	Microbiological assay of antibiotics by cup plate method	**CO4**
12	Microbiological assay of vitamins by Turbidimetric method	**CO5**
13	Determination of RWC	**CO5**
14	Diagnostic tests for some common diseases, Widal, malarial parasite	**CO6**

Text Books:

1. Vanitha Kale and Kishor Bhusari "Applied Microbiology" Himalaya Publishing house, Mumbai.
2. Mary Louis Turgeon "Immunology and Serology in Laboratory Medicines" 2nd edition, 1996 Mosby- Yearbook inc St. Louis Missouri

Reference Books:

1. Prescot L.M., Jarley G.P Klein D.A "Microbiology" 2nd- edition Mc Graw Hill Company Inc.
2. Rawlins E.A. "Bentley's Text Book of Pharmaceutics" Bailliere Tindals 24- 28 London 1988.
3. Frobisher "Fundamentals of Microbiology" Philadelphia W.B. Saunders.

Web Links:

W1: https://microbenotes.com/widal-test/
W2:https://microbeonline.com/overview-of-biochemical-tests-used-to-identify-bacteria-in-microbiology-laboratory/
W3: https://pvpkm.ac.in/upload/StudyMaterial/Pure%20Culture%20Techniques.pdf
W4:https://acmeresearchlabs.in/2024/03/28/minimum-inhibitory-concentration-mic-test-protocol/#:~:text=Minimum%20Inhibitory%20Concentration%20%28MIC%29%20Test%20Protocol%3A%20The%20MIC,prevent%20the%20visible%20growth%20of%20a%20specific%2 0microorganism.
W5:https://sherubtsebotmal.wordpress.com/2021/03/18/aim-to-measure-the-of-relative-water-content-rwc-in-plant-tissue/

PHARMACOGNOSY AND PHYTOPHARMACEUTICALS (Theory)

Course Code: 2516PY15

Course Objectives: Upon completion of the course, the student shall be able to

COB1: to know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents

COB2: to understand the preparation and development of herbal formulation.

COB3: to understand the herbal drug interactions

COB4: to carryout isolation and identification of phytoconstituents

Course Outcomes: At the end of the course, the student will be able to

CO1: Introduction, Definition, history and scope of Pharmacognosy.

CO2: Understand the basic cultivation, collection and storage of crude drugs. Classification of crude drugs. Detailed method of cultivation of crude drugs. Microscopical and powder Microscopical study of crude drugs.

CO3: Detailed study of various cell constituents. Study of cell wall constituents and cell inclusions. Study of natural pesticides.

CO4: Detailed study carbohydrates containing drugs. Carbohydrates and related products

CO5: Definition sources, method extraction, chemistry and method of analysis of lipids. Detailed study of oils

CO6: Definition sources, method extraction, chemistry and method of analysis of lipids. Detailed study of oils. Definition, classification, chemistry and method of analysis of protein. Study of plants fibers used in surgical dressings and related products. Different methods of adulteration of crude drugs

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3			2		2	3	3	1	1	3
CO2	3			2		2	3	3	1	1	3
CO3	3			2		2	3	3	1	1	3
CO4	3			2		2	3	3	1	1	3
CO5	3			2		2	3	3	1	1	3
CO6	3			2		2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	3
CO3	2	3
CO4	3	2
CO5	3	2
CO6	3	3

Lecture wise Programme: **3 Hrs/Week**

Unit I

1. Introduction.
2. Definition, history and scope of Pharmacognosy.
3. Classification of crude drugs.
4. Cultivation, collection, processing and storage of crude drugs.
5. Detailed method of cultivation of crude drugs.
6. Study of cell wall constituents and cell inclusions.
7. Microscopical and powder Microscopical study of crude drugs.
8. Study of natural pesticides. Detailed study of various cell constituents.
9. Carbohydrates and related products.
10. Detailed study carbohydrates containing drugs.(11 drugs)
11. Definition sources, method extraction, chemistry and method of analysis of lipids.
12. Detailed study of oils.
13. Definition, classification, chemistry and method of analysis of protein.
14. Study of plants fibers used in surgical dressings and related products.
15. Different methods of adulteration of crude drugs.

Text Books:

1. Pharmacognosy by G.E. Trease & W.C.Evans.
2. Pharmacognosy by C.K.Kokate,Gokhale & A.C.Purohit.

Reference Books:

1. Pharmacognosy by Brady &Tyler.E.
2. Pharmacognosy by T.E.Wallis.
3. Pharmacognosy by C.S. Shah & Qadery.

Web Links:

W1: https://biologyease.com/crude-drugs-collection-processing-and-storage/

W2: https://silverlineservices.blogspot.com/2016/03/study-of-cell-constituents-and-cell.html

W3 https://www.scribd.com/document/642166215/Fibres-Sutures-And-Surgical-Dressings

W4: https://ebooks.inflibnet.ac.in/biocp03/chapter/separation-and-analysis-of-lipids/

W5: https://www.pharmaacademias.com/extraction-definition-classification-methods-and-applications/

PHARMCOGNOSY AND PHYTOPHARMACEUTICALS-PRACTICAL

Subject Code: 2516PY20

Course Objectives: Upon completion of the course, the student shall be able to
COB1. Understand the basic principles of cultivation, collection and storage of crude drugs
COB2. Know the source, active constituents and uses of crude drugs; and
COB3. Appreciate the applications of primary and secondary metabolites of the plant.
COB4. Perform evaluation of crude drugs.
COB5. Apply chromatographic methods for standardization**.**

Course Outcomes: At the end of the course, the student will be able to:
CO1: Identify the mixture of sample components by Paper chromatography and TLC and interpretation of chromatograms
CO2: Analyse the compounds by various spectroscopic instruments like spectrophotometers, fluorimeters, flame photometer
CO3: Determine conductometric and potentiometric titrations of mixture of acids and bases
CO4: Demonstrate the working and analyzing compounds by HPLC, HPTLC instruments
CO5: Develop the working and analyzing compounds by , GC-MS, DSC instruments
CO6: Justify IR and NMR Spectra

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3			2		2	3	3	1	1	3
CO2	3			2		2	3	3	1	1	3
CO3	3			2		2	3	3	1	1	3
CO4	3			2		2	3	3	1	1	3
CO5	3			2		2	3	3	1	1	3
CO6	3			2		2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	3
CO3	2	3
CO4	3	3
CO5	3	3
CO6	2	3

Lecture wise Programme: **3 Hrs/Week**

List of Experiments:

Expt. No	Title	CO
1	Introduction of pharmacognosy laboratory and experiments	CO1
2	Study of cell wall constituents and cell inclusions	CO1
3	Macro, Powder and Microscopic study of Datura	CO2
4	Macro, Powder and Microscopic study of Senna	CO2
5	Macro, Powder and Microscopic study of cassia	CO2
6	Macro, Powder and Microscopic study of Cinnamon	CO2
7	Macro, Powder and Microscopic study of Cinchona	CO2
8	Macro, Powder and Microscopic study of Ephedra	CO2
9	Macro, Powder and Microscopic study of Quassia	CO3
10	Macro, Powder and Microscopic study of Clove	CO3
11	Macro, Powder and Microscopic study of Fennel	CO3
12	Macro, Powder and Microscopic study of Coriander	CO3
13	Macro, Powder and Microscopic study of Isphagol	CO3
14	Macro, Powder and Microscopic study of Nuxvomica	CO4
15	Macro, Powder and Microscopic study of Rauwolfia	CO4
16	Macro, Powder and Microscopic study of Liquorice	CO4
17	Macro, Powder and Microscopic study of Ginger	CO4
18	Macro, Powder and Microscopic study of Podophyllum	CO4
19	Determination of Iodine value of the given oil or fat	CO4
20	Determination of Saponification value of the given oil or fat and Unsaponifiable matter	CO5
21	Determination of Ester value of given oil or fat	CO5
22	Determination of acid value of the given oil or fat	CO5
23	Chemical tests for lipids(castor oil, Sesame oil, Bees wax)	CO6
24	Chemical tests for Acacia	CO6
25	Chemical tests for Agar	CO6
26	Chemical tests for Tragacanth	CO6

Text Books:

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers' medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York

Reference Books:

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology(vol1 and 2) by Dr. C.C. Chatterrje, Academic Publishers Kolkata

Web Links:

W1: https://pharmaknowledgeforum.com/analytical-techniques/
W2:https://www.ijpsjournal.com/assetsbackoffice/uploads/article/Analytical+Techniques+in+Pharmaceutical+Analysis++.pdf
W3: https://egyankosh.ac.in/bitstream/123456789/43276/1/Exp-3.pdf
W4: https://www.biologydiscussion.com/amino-acids/separation-of-amino-acids-by-paper-chromatography-with-diagram/180003
W5: https://chem.pg.edu.pl/documents/175260/14212622/chf_epm_lab_1.pdf

PHARMACOLOGY I (Theory)

Course Code: 2516PY16

Couse Objectives: Upon completion of the subject student shall be able to

COB1: understand the pharmacological aspects of drugs falling under the above mentioned chapters;

COB2: handle and carry out the animal experiments;

COB3: appreciate the importance of pharmacology subject as a basis of therapeutics; and

COB4: correlate and apply the knowledge therapeutically.

COB5: To explore drug interactions and factors modifying drug action, including age, weight, genetic factors, and disease states.

COB6: To introduce the principles of toxicology, including types of poisons and their management.

Course Outcomes At the end of the course, the student will be able to:

CO1: Understand the basic concepts of pharmacology, including sources of drugs, dosage forms, routes of administration, and general pharmacological principles.

CO2: Describe pharmacokinetics (ADME) and pharmacodynamics, including mechanisms of drug action and factors affecting drug response.

CO3: Classify drugs affecting the autonomic nervous system (ANS) and explain their mechanism of action, uses, and adverse effects.

CO4: Understand the pharmacology of drugs acting on the central nervous system (CNS) and cardiovascular system (CVS).

CO5: Explain drug interactions, contraindications, and the rationale for rational drug therapy.

CO6: Develop awareness of toxicology, types of poisons, symptoms of poisoning, and their management.

Mapping of Course Outcomes with Program Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3		3	2	2	2	2	1	2		2
CO2	3		3	3	2	2	2	1	2		2
CO3	3		3	3	2	2	2	1	2		2
CO4	3		2	3	2	2	2	1	3		2
CO5	3		2	3	2	2	2	1	3		2
CO6	3		2	3	2	2	2	1	2		2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	3
CO4	3	3
CO5	3	3
CO6	3	3

Lecture wise Programme : **3 Hrs. /Week**

1. General Pharmacology

a) Introduction, definitions and scope of pharmacology
b) Routes of administration of drugs
c) Pharmacokinetics (absorption, distribution, metabolism and excretion)
d) Pharmacodynamics
e) Factors modifying drug effects
f) Drug toxicity - Acute, sub- acute and chronic toxicity.
g) Pre-clinical evaluations
h) Drug interactions

Note: The term Pharmacology used here refers to the classification, mechanism of action, pharmacokinetics, pharmacodynamics, adverse effects, contraindications, Therapeutic uses, interactions and dose and route of administration.

2. Pharmacology of drugs acting on ANS

a. Adrenergic and antiadrenergic drugs
b. Cholinergic and anticholinergic drugs
c. Neuromuscular blockers
d. Mydriactics and miotic
e. Drugs used in myasthenia gravis
f. Drugs used in Parkinsonism

3. Pharmacology of drugs acting on cardiovascular system

a. Antihypertensives
b. Anti-anginal drugs
c. Anti-arrhythmic drugs
d. Drugs used for therapy of Congestive Heart Failure
e. Drugs used for hyperlipidemias

4. Pharmacology of drugs acting on Central Nervous System

a. General anesthetics
b. Sedatives and hypnotics
c. Anticonvulsants
d. Analgesic and anti-inflammatory agents
e. Psychotropic drugs
f. Alcohol and methyl alcohol
g. CNS stimulants and cognition enhancers
h. Pharmacology of local anesthetics

5. Pharmacology of Drugs acting on Respiratory tract

a. Bronchodilators
b. Mucolytics
c. Expectorants
d. Antitussives
e. Nasal Decongestants

6. Pharmacology of Hormones and Hormone antagonists

a. Thyroid and Anti-thyroid drugs

b. Insulin, Insulin analogues and oral hypoglycemic agents

c. Sex hormones and oral contraceptives
d. Oxytocin and other stimulants and relaxants

7. Pharmacology of autacoids and their antagonists

a. Histamines and Anti-histaminics
b. 5-Hydroxytryptamine and its antagonists
c. Lipid derived autacoids and platelet activating factor

Text books

(Author, Title, Edition, Publication Place, Publisher, Year of Publication)

a. Tripathi, K. D. Essentials of medical pharmacology. 4th Ed, 1999. Publisher: Jaypee, Delhi.

b. Satoskar, R.S. and Bhadarkar, S.D. Pharmacology and pharmacotherapeutics. 16th edition (single volume), 1999. Publisher: Popular, Dubai

Reference books

a. Goodman Gilman, A., Rall, T.W., Nies, A.I.S. and Taylor, P. Goodman and Gilman's The pharmacological Basis of therapeutics. 9th Ed, 1996. Publisher Mc Graw Hill, Pergamon press.

b. Craig, C.R.&Stitzel, R.E. Modern Pharmacology. Latest edition. Publisher: Little Brown.Co

Web Links :

W1: https://med.libretexts.org/Bookshelves/Pharmacology_and_Neuroscience/Book%3A_Principles_of_Pharmacology_(Rosow_Standaert_and_Strichartz)/01%3A_Chapters/1.02%3A_Introduction_to_Pharmacology

W2: https://www.carewellpharma.in/bpharmacy/notes/4th-sem/pharmacology-1/unit-1/#google_vignette

W3: https://pharmdbm.com/pharmacology-1-notes-bpharm-unit-2/

W4: https://depthofbiology.com/bpharm-notes/2nd-year-notes/semester-4-notes/bp404t-pharmacology-i-notes/#google_vignette

W5: https://noteskarts.com/free-pharmacology-1-pdf-notes-b-pharmacy-4th-semester/

COMMUNITY PHARMACY- THEORY

Subject code 2516PY17

Course Objectives: Upon completion of the course, the student shall be able to know pharmaceutical care services;

COB 1: know the business and professional practice management skills in community pharmacies.

COB2: do patient counseling & provide health screening services to public in community pharmacy.

COB3; respond to minor ailments and provide appropriate medication;

Show empathy and sympathy to patients; and appreciate the concept of Rational drug therapy.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Roles and responsibilities of Community pharmacist in managing and maintenance business of a community pharmacy.

CO2. The parts of prescription, legality & identification of medication related problems like drug interactions.

CO3: Various methods of inventory management.

CO4: Gain knowledge on pharmaceutical care, patient medication adherence, health screening services and OTC medication.

CO5: Concept of health education as per WHO, study about commonly occurring communicable diseases, causative agents, clinical presentations and prevention of communicable diseases, balanced diet, and treatment & prevention of deficiency disorders, family planning.

CO6: Symptoms of minor ailments and provide appropriate medication

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	1	2	2	1	2	2	1	2
CO2	3	1	2	1	2	2	1	2	2	1	2
CO3	3	1	2	1	2	2	1	2	2	1	2
CO4	3	1	2	1	2	2	1	2	2	1	2
Co5	3	1	2	1	2	2	1	2	2	1	2
CO6	3	1	2	1	2	2	1	2	2	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	1
CO4	3	3
CO5	3	3
CO6	3	2

Lecture wise Programme: **3 Hrs/Week**

1. Definition, scope, of community pharmacy

Roles and responsibilities of Community pharmacist

2. Community Pharmacy Management

a. Selection of site, Space layout, and design

b. Staff, Materials- coding, stocking

c. Legal requirements

d. Maintenance of various registers

e. Use of Computers: Business and health care soft wares

3. **Prescriptions** – parts of prescription, legality & identification of medication related problems like drug interactions.

4. Inventory control in community pharmacy Definition, various methods of Inventory Control **ABC, VED, EOQ, Lead time, safety stock**

5. Pharmaceutical care

Definition and Principles of Pharmaceutical care.

6. Patient counselling

Definition, outcomes, various stages, barriers, Strategies to overcome barriers Patient information leaflets- content, design, & layouts, advisory labels

7. Patient medication adherence

Definition, Factors affecting medication adherence, role of pharmacist in improving the adherence.

8. Health screening services

Definition, importance, methods for screening Blood pressure/ blood sugar/ lung function and Cholesterol testing

9. OTC Medication- Definition, OTC medication list & Counselling

10. 10 Health Education

WHO Definition of health, and health promotion, care for children, pregnant & breast feeding women, and geriatric patients.

Commonly occurring Communicable Diseases, causative agents,

Clinical presentations and prevention of communicable diseases – Tuberculosis, Hepatitis, Typhoid, Amoebiasis, Malaria, Leprosy,

Syphilis, Gonorrhea and AIDS

Balance diet, and treatment & prevention of deficiency disorders Family planning – role of pharmacist

11. Responding to symptoms of minor ailments

Relevant pathophysiology, common drug therapy to,

Pain, GI disturbances (Nausea, Vomiting, Dyspepsia, diarrhea, constipation), Pyrexia, Opthalmic symptoms, worms infestations.

12. Essential Drugs concept and Rational Drug Therapy Role of community pharmacist

13. Code of ethics for community pharmacists

Text Books:

1. Health Education and Community Pharmacy by N.S.Parmar.

2. Health education & Community pharmacy by N.K. Jain

Reference books:

1. Handbook of pharmacy – health care.Edt. Robin J Harman. The Pharmaceutical press.
2. Comprehensive Pharmacy Review – Edt. Leon Shargel. Lippincott Williams & Wilkins.

Web links:

W1: https://www.researchgate.net/publication/351173825_community_Pharmacy

W2:https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/downloads/Role_of_communit_pharmacist_in_ensuring_better_healthcare.pdf

W3:http://courseware.cutm.ac.in/wp-content/uploads/2020/06/codeofethicsforcommunitypharamcists-180623145009.pdf

W4:https://www.slideshare.net/rameshganpisetti/staff-requirments-and-material-coding-in-community-pharmacy

W5: https://www.who.int/news-room/fact-sheets/detail/healthy-diet

PHARMACOTHERAPEUTICS -I

Subject Code – 2516PY18

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

COB1: Analyse about Rationality of drugs in the field of pharmacy.

COB2: Understand about scope of Antibacterial Stewardship program in avoiding Antibiotic resistance.

COB3: Compare the differences between Lower & Upper respiratory tract infections & STD 's.

COB4: Understand the concepts of Various diseases like Coronary artery disease, Cardiac arrythmias, Renal dysfunction.

Courses Outcomes: At the end of the course, the student will be able to:

CO1: Explain the pathophysiology & management of lower respiratory tract infections.

CO2: Describe the general prescribing guidelines and rational use of drugs in geriatric patients.

CO3: Explain the pathophysiology management of Respiratory endocrine diseases.

CO4: Discuss the pathophysiology management of Glaucoma & Viral bacterial conjunctivitis.

CO5 : Recognise the role of the pharmacist in essential and rational drug use.

CO6: Define the common etiopathogenesis of cardiovascular diseases.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3			2		2	3	3	1	1	3
CO2	3			2		2	3	3	1	1	3
CO3	3			2		2	3	3	1	1	3
CO4	3			2		2	3	3	1	1	3
CO5	3			2		2	3	3	3	3	3
CO6	3			2		2	3	3	3	3	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	3	3
CO5	2	3
CO6	2	3

Lecture wise Programme: **3Hrs. / Week**

UNIT I.

Cardiovascular system: Hypertension, Congestive cardiac failure, Angina Pectoris, Myocardial infarction, , Hyperlipidaemias , Electrophysiology of heart and Arrhythmias

UNIT

Respiratory system : Introduction to Pulmonary function test, Asthma, Chronic obstructive airways disease, Drug induced pulmonary diseases Endocrine system : Diabetes, Thyroid diseases, Oral contraceptives, Hormone replacement therapy, Osteoporosis

UNIT III

General prescribing guidelines for a. Paediatric patients b. Geriatric patients c. Pregnancy and breast feeding.

UNIT IV.

Ophthalmology: Glaucoma, Conjunctivitis- viral & bacterial.

UNIT V

Introduction to rational drug use Definition, Role of pharmacist Essential drug concept Rational drug formulations.

Text Books

1. Clinical Pharmacy and Therapeutics - Roger and Walker, Churchill Livingstone publication
2. Pharmacotherapy: A Pathophysiologic approach - Joseph T. Dipiro et al. Appeton & Lange

Reference:

1. Clinical pharmacy and Therapeutics - Eric T.Herfindal, Williams and Wilkins Publication.
2. PHARMACOTHERAPY HANDBOOK (SPECIAL INDIA EDITION) –Joseph T.Dipiro, Gary C Yee.

Web links :

W1 : https://usahidsolo.ac.id/digilib/repository/Dipiro_Pharmacotherapy_7th.pdf

W2: https://alazharpharmacy.com/documents/level-5/semester-1/pharmacotherapeutics-1/Clinical-Pharmacy-and-Therapeutics-roger-walker-5th.pdf

W3: https://dokumen.pub/pharmacotherapy-a-pathophysiologic-approach-11nbsped-9781260116823-1260116824-9781260116816-1260116816.html

W4: https://www.slideshare.net/slideshow/pathophysiology-of-cancer/232614422.

W5: https://www.slideshare.net/slideshow/general-prescribing-guidelines-for-pediatrics-geriatrics-and-pregnancy/138606858

PHARMACOTHERAPEUTICS I (PRACTICAL)

Subject Code: 2516PY21

Course Objectives: Upon the completion of the course students will be able to understand

COB1: The pathophysiology of selected disease states and the rationale for drug therapy;

COB2: The therapeutic approach to management of these diseases;

COB3: The controversies in drug therapy;

COB4: The importance of preparation of individualized therapeutic plans based on diagnosis;

COB5: Needs to identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time-course of clinical and laboratory indices of therapeutic response and adverse effects);

COB6: Describe the pathophysiology of selected disease states and explain the rationale for drug therapy;

Course Outcomes : At the end of the course, the student will be able to:

CO1 : Identify drug interactions and rationalize the prescription (Remember)

CO2 : Discuss the therapeutic approach to management of selected diseases (Understand)

CO3 : Calculate individualized therapeutic plans based on diagnosis(Apply)

CO4 : Show patient counseling(Apply)

CO5 : Arrange planned experiments and prepare laboratory report in a standard format(Remember)

CO6 : Identify the controversies in drug therapy(Remember)

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3		2	1							3
CO2	3		2	1							2
CO3	3		2	1		2		2			2
CO4	3		2	1				2	3	2	2
CO5	3		2	1				1	2		2
CO6	3	2	1		2		1.6	2.5	2	2.2	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	3
CO4	3	2
CO5	3	3
CO6	3	2

Lecture wise Programme: **3 Hrs/Week**

List of Experiments:

SNo	Name of the Experiment	Course objective
1	Case study on CAD associated with Hypertension & type 2 Diabetes .	**CO2**
2	Case study on Cardiac arrthymias with heartfailure.	**CO3**
3	Case study on Glucoma associated type 2 Dm	**CO5**
4	Case study on Hypertension with AWMI	**CO2**
5	Case study on Gastritis with COPD.	**CO5**
6	Case study on Hepatitis B infection associated Jaundice	**CO6**

Text Books

1. Clinical Pharmacy and Therapeutics - Roger and Walker, Churchill Livingstone publication
2. Pharmacotherapy: A Pathophysiologic approach - Joseph T. Dipiro et al. Appeton & Lange

Reference Books

1. Pathologic basis of disease - Robins SL, W.B.Saunders publication
2. Pathology and therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice -Green and Harris, Chapman and Hall publication
3. Clinical Pharmacy and Therapeutics - Eric T. Herfindal, Williams and Wilkins Publication.

Web Links :

W1:Roger-Walker-Clinical-Pharmacy-and-Therapeutics-5th-Ed..pdf-GoogleDrive

W2:DiPiro'sPharmacotherapy:APathophysiologicApproach,12thEdition|AccessPharmacy|McGrawHillMedical(mhmedical.com)

W3: https://www.pharmacyinfoline.com/pharm-d-syllabus/pharm-d-year-wise-subjects/pharm-d- 4th-year/pharmacotherapeutics-iii/

W4: https://www.scribd.com/document/693465268/PHARMACOTHERAPEUTICS-III-FOURTH-PHARM-D

W5: https://pharmdguru.com/category/pharmacotherapeutics-3/

3rd YEAR

PHARMACOLOGY – II (THEORY)

Course Code: 2516PY22

Course Objectives: Upon the completion of the course students will be able to

COB1: Understand the pharmacological aspects of drugs falling under the above-mentioned chapters

COB2: Carry out the animal experiments confidently

COB3: Appreciate the importance of pharmacology subject as a basis of therapeutics

COB4: Correlate and apply the knowledge therapeutically.

COB5: Interpret dose-response curves using isolated tissue preparations.

COB6: Understand the concept of bioassays using different methods.

Course Outcomes: At the end of the course, the student will be able to:

CO1 Demonstrate a thorough understanding of the mechanisms of action, therapeutic uses, and side effects of drugs covered in the course.

CO2 Perform and interpret pharmacological experiments on animals with confidence and precision.

CO3 Appreciate the role of pharmacology as a foundational science in the development and application of therapeutic interventions.

CO4 Correlate pharmacological principles with clinical scenarios to make informed therapeutic decisions.

CO5 Analyze and predict potential drug interactions and adverse effects based on pharmacological knowledge.

CO6 Critically evaluate and synthesize current pharmacological research to stay updated with advancements in drug therapy and development.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1
CO1	3	1	1	2	1	2	3	3	1	1	3
CO2	3	1	1	2	1	2	3	3	1	1	3
CO3	3	1	1	2	1	2	3	3	1	1	3
CO4	3	1	1	2	1	2	3	3	1	1	3
CO5	3	1	1	2	1	2	3	3	1	1	3
CO6	3	1	1	2	1	2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	2	2
CO6	2	2

Lecture wise Programme: **3 Hrs/Week**

Unit 1: Pharmacology of Drugs Acting on Blood and Blood Forming Agents

a. Anticoagulants
b. Thrombolytics and Antiplatelet Agents
c. Haemopoietics and Plasma Expanders

Unit 2: Pharmacology of Drugs Acting on Renal System

Diuretics

a. Antidiuretics

Unit 3: Chemotherapy

a. Introduction
b. Sulfonamides and Co-trimoxazole
c. Penicillins and Cephalosporins
d. Tetracyclins and Chloramphenicol
e. Macrolides, Aminoglycosides, Polyene & Polypeptide Antibiotics
f. Quinolines and Fluroquinolines
g. Antifungal Antibiotics
h. Antiviral Agents
i. Chemotherapy of Tuberculosis and Leprosy
j. Chemotherapy of Malaria
k. Chemotherapy of Protozoal Infections (Amoebiasis, Giardiasis)
l. Pharmacology of Anthelmintic Drugs
m. Chemotherapy of Cancer (Neoplasms)

Unit 4: Immunopharmacology

Pharmacology of Immunosuppressants and Stimulants

Unit 5: Principles of Animal Toxicology

a. Acute Toxicity
b. Sub-acute Toxicity
c. Chronic Toxicity

Unit 6: The Dynamic Cell

a. Cell and Macromolecules: Cellular Classification, Subcellular Organelles, Macromolecules,
Large Macromolecular Assemblies

b. Chromosome Structure: Prokaryotic and Eukaryotic Chromosome Structures, Chromatin Structure, Genome Complexity, the Flow of Genetic Information

c. DNA Replication: General, Bacterial, and Eukaryotic DNA Replication

d. The Cell Cycle: Restriction Point, Cell Cycle Regulators and Modifiers

e. Cell Signaling: Communication Between Cells and Their Environment, Ion-Channels, Signal Transduction Pathways (MAP Kinase, P38 Kinase, JNK, Ras and PI3-Kinase Pathways, Biosensors)

Unit 7: The Gene: Genome Structure and Function

a. Gene Structure: Organization and Elucidation of Genetic Code

b. Gene Expression: Expression Systems (Prokaryotic and Eukaryotic), Genetic Elements That Control Gene Expression (Nucleosomes, Histones, Acetylation, HDACs, DNA Binding Protein Families)

c. Transcription and Transcription Factors: Basic Principles of Transcription in Prokaryotes and Eukaryotes. Transcription Factors That Regulate Transcription in Prokaryotes and Eukaryotes.
RNA Processing: rRNA, tRNA and mRNA Processing
d. Protein Synthesis: Mechanisms of Protein Synthesis, Initiation in Eukaryotes, Translation Control and Post-Translation Events
e. Altered Gene Functions: Mutations, Deletions, Amplifications, LOH, Translocations, Trinucleotide Repeats and Other Genetic Abnormalities. Oncogenes and Tumor Suppressor Genes
f. Gene Sequencing, Mapping and Cloning of Human Disease Genes
g. Introduction to Gene Therapy and Targeting
h. Recombinant DNA Technology: Principles, Processes (Gene Transfer Technology), and Applications

Text Books:

1. Tripathi, K. D. Essentials of medical pharmacology. 4th edition, 1999. Publisher: Jaypee, Delhi.

2. Satoskar, R.S. and Bhadarkar, S.D. Pharmacology and pharmacotherapeutics. 16th edition (single volume), 1999. Publisher: Popular, Dubai.

References:

1. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, TataMc Graw-Hill
2. 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.,
3. Applied Therapeutics, The Clinical use of Drugs, The PointLippincott Williams & Wilkins Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's IllustratedReviewsPharmacology.

Web Resources:

W1: https://www.sciencedirect.com/science/article/pii/S1319016420301833
W2: https://www.pharmaguideline.com/2021/10/forms-of-intracellular-signaling.html
W3: https://www.sth.nhs.uk/clientfiles/File/AP%20and%20%20HF%202019.pdf
W4: https://my.clevelandclinic.org/health/body/22827-integumentary-system
W5:https://pressbooks-dev.oer.hawaii.edu/anatomyandphysiology/chapter/an-overview-of-blood/

PHARMACOLOGY – II (PRACTICAL)

Course Code: 2516PY28

Course Objectives: Upon completion of the course, the student shall be able to

COB1: Familiarize students with the handling and care of various laboratory animals used in pharmacological experiments.

COB2: Teach the preparation and use of physiological salt solutions in experimental pharmacology.

COB3: Introduce the laboratory appliances commonly used in pharmacological research.

COB4: Instruct students on the use of anesthetics in laboratory animals.

COB5: Train students to record and interpret dose-response curves using isolated tissue preparations.

COB6: Provide hands-on experience in conducting bioassays using different methods.

COB7: Educate students on the routes of drug administration in animals.

COB8: Enhance students' understanding of experimental techniques and data interpretation for various pharmacological activities.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1 Demonstrate the ability to handle and care for laboratory animals such as frogs, mice, rats, guinea pigs, and rabbits.

CO2 Prepare and utilize physiological salt solutions effectively in pharmacological experiments.

CO3 Identify and use laboratory appliances appropriately in experimental pharmacology.

CO4 Apply the principles and procedures for using anesthetics in laboratory animals.

CO5 Record and interpret dose-response curves for acetylcholine and histamine using isolated tissue preparations.

CO6 Conduct bioassays of acetylcholine and histamine using interpolation and three-point methods.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	2	2	2	3	3	1	1	3
CO2	3	1	1	2	2	2	3	3	1	1	3
CO3	3	1	1	2	2	2	3	3	1	1	3
CO4	3	1	1	2	2	2	3	3	1	1	3
CO5	3	1	1	2	2	2	3	3	1	1	3
CO6	3	1	1	2	2	2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	2	2
CO6	2	2

Lecture wise Programme: **3 Hrs/Week**

List of Experiments:

EX.NO	Title	CO
1.	Study of laboratory animals and their handling (a. Frogs, b. Mice, c. Rats, d. Guinea pigs, e. Rabbits).	**CO1**
2.	Study of physiological salt solutions used in experimental pharmacology.	**CO1**
3.	Study of laboratory appliances used in experimental pharmacology.	**CO1**
4.	Study of use of anesthetics in laboratory animals.	**CO2**
5.	To record the dose response curve of Ach using isolated ileum/rectus abdominis muscle preparation.	**CO2**
6.	To carry out bioassay of Ach using isolated ileum/rectus abdominis muscle preparation by interpolation method.	**CO3**
7.	To carry out bioassay of Ach using isolated ileum/rectus abdominis muscle preparation by three point method.	**CO3**
8.	To record the dose response curve of Histamine using isolated guinea-pig ileum preparation.	**CO3**
9.	Study of agonistic and antagonistic effects of drugs using isolated guinea-pig ileum preparation.	**CO4**
10.	To carry out bioassay of Histamine using isolated guinea-pig ileum preparation by interpolation method.	**CO4**
11.	To carry out bioassay of Histamine using guinea-pig ileum preparation by three point method.	**CO5**
12.	To study the routes of administration of drugs in animals (Rats, Mice, Rabbits).	**CO5**
13.	Study of theory, principle, procedure involved and interpretation of given results for the following experiments:	**CO6**
14.	Analgesic property of drug using analgesiometer.	**CO6**
15.	Antiinflammatory effect of drugs using rat-paw edema method.	**CO6**
16.	Anticonvulsant activity of drugs using maximal electroshock and pentylene tetrazole methods.	**CO6**
17.	Antidepressant activity of drugs using pole climbing apparatus and pentobarbitone induced sleeping time methods.	**CO6**
18.	Locomotor activity evaluation of drugs using actophotometer and rotorod.	**CO6**
19.	Cardiotonic activity of drugs using isolated frog heart and mammalian heart preparations.	**CO6**
20.	Study of laboratory animals and their handling (a. Frogs, b. Mice, c. Rats, d. Guinea pigs, e. Rabbits).	**CO6**

Text books

1. Kulkarni, S. K. and Dandia, P. C. Hand book of experimental pharmacology. Latest edition, Publisher: Vallab, Delhi.
2. Ghosh, M.N. Fundamentals of experimental pharmacology. Latest edition, Publisher: Scientific book agency, Kolkata.

Reference books:

1. Macleod, L.J. Pharmacological experiments on intact preparations. Latest edition, Publisher: Churchill livingstone.
2. Macleod, L.J. Pharmacological experiments on isolated preparations. Latest edition, Publisher: Churchill livingstone.

Web Links:

W1: https://www.ncbi.nlm.nih.gov/books/NBK21511/
W2: https://vlab.amrita.edu/?sub=3&brch=65
W3: http://www.protocol-online.org/prot/Pharmacology/
W4: https://www.guidetopharmacology.org/
W5: https://learn.chm.msu.edu/vibl/index.html

PHARMACEUTICAL ANALYSIS (Theory)

subject Code: 2516PY23

Course Objectives: Upon completion of the course, the student shall be able to

COB1: cGMP, QC tests, documentation, quality certifications and regulatory affairs

COB2: understand the calibration of various analytical instruments

COB3: understand the electrochemical methods of analysis

COB4: understand the advanced instruments used and its applications in drug analysis

COB5: understand the chromatographic separation and analysis of drugs.

COB6: know analysis of drugs using various analytical instruments.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Discuss the sources and control of quality variations, validation methods, GLP, ISO 9000, ICH guidelines and their importance in pharmaceutical industry (UNDERSTAND)

CO2: Develop chromatographic techniques with relevant examples of pharmaceutical products involving principles and techniques of separation of drugs from excipients. (CREATE)

CO3: Summarize on theoretical aspects, instrumentation, interpretation of data/spectra and analytical applications of Electrochemical methods of analysis (UNDERSTAND)

CO4: Enumerate theoretical aspects, instrumentation, elements of interpretation of data/spectra and application of analytical spectroscopy (REMEMBER)

CO5: Explain theoretical aspects, instrumentation, elements of interpretation of data/spectra and application of polarimetry and X-ray diffraction techniques (UNDERSTAND)

CO6: Describe theoretical aspects, instrumentation, elements of interpretation of data/spectra and application of Thermal analysis (REMEMBER)

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	3	1		2		2		2	3
CO2	3	2	3	2		2		2			2
CO3	3	2	3	1		2		2			2
CO4	3	2	3	2		2		2			2
CO5	3	2	3	2		2		2			2
CO6	3	2	3	2		2		2			2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	2
CO4	2	2
CO5	2	2
CO6	2	3

Lecture wise Programme: **3 Hrs/Week**

1. Quality Assurance:

a. Introduction, sources of quality variation, control of quality variation.

b. Concept of statistical quality control.

c. Validation methods- quality of equipment, validation of equipment and validation of analytical instruments and calibration.

d. GLP, ISO 9000.

e. Total quality management, quality review and documentation.

f. ICH- international conference for harmonization-guidelines.

g. Regulatory control.

2. Chromatography:

Introduction, history, classification, separation techniques, choice of methods. The following techniques be discussed with relevant examples of pharmaceutical products involving principles and techniques of separation of drugs from excipients.

a. **Column Chromatography:** Adsorption column chromatography, Operational technique, frontal analysis and elution analysis. Factors affecting column efficiency, applications and partition chromatography.

b. TLC: Introduction, principle, techniques, Rf value and applications.

c. HPLC: Introduction, principle, types of paper chromatography, preparation techniques, development techniques, applications.

d. Ion-exchange chromatography: Introduction, principles, types of ion exchange synthetic resins, physical properties, factors affecting ion exchange, methodology and applications.

e. HPLC: Introduction, theory, instrumentation, and applications.

f. HPTLC: Introduction, theory, instrumentation, and applications.

g. Gas Chromatography: Introduction, theory, instrumentation-carrier gases, types of columns, stationary phases in GLC & GSC. DetectorsFlame ionization detectors, electron capture detector, thermal conductivity detector. Typical gas chromatogram, derivatisation techniques, programmed temperature gas chromatography, applications.

h. Electrophoresis: Principles of separation, equipment for paper and gel electrophoresis, and application.

i. Gel filtration and affinity chromatography: Introduction, technique, applications.

3. **Electrometric Methods:**

Theoretical aspects, instrumentation, interpretation of data/spectra and analytical applications be discussed on the following topics.

a. Potentiometry: Electrical potential, electrochemical cell, reference electrodes, indicator electrodes, measurement of potential and pH, construction and working of electrodes, Potentiometric titrations, methods of detecting end point, Karl Fischer titration.

b. Conductometry: Introduction, conductivity cell, conductometric titrations and applications.

c. Polarography: Instrumentation, DME, residual current, diffusion current and limiting current, polarographic wave, Ilkovic's equation, Effect of oxygen on polarographic wave, Polarographic maxima and suppressors and applications.

d. Amperometric Titrations: Introduction, types of electrodes used, reference and indicator electrode, instrumentation, titration procedure, advantages and disadvantages of Amperometry over potentiometry. Pharma applications.

4. **Spectroscopy:**

Theoretical aspects, instrumentation, elements of interpretation of data/spectra and application of analytical techniques be discussed on:

a. **Absorption Spectroscopy:**

- Theory of electronic, atomic and molecular spectra. Fundamental laws of photometry, Beer-Lambert's Law, application and its deviation, limitation of Beer law, application of the law to single and multiple component analysis, measurement of equilibrium constant and rate constant by spectroscopy. Spectra of isolated chromophores, auxochromes, batho-chromic shift, hypsochromic shift, hyperchromic and hypochromic effect, effect of solvent on absorption spectra, molecular structure and infrared spectra.
- **Instrumentation** – Photometer, U.V.-Visible spectrophotometer – sources of U.V.-Visible radiations, collimating systems, monochromators, samples cells and following detectors-

Photocell, Barrier layer cell, Phototube, Diode array, applications of U.V.-Visible spectroscopy in pharmacy and spectrophotometric titrations.

- **Fluorimetric Analysis:** Theory, luminescence, factors affecting fluorescence, quenching. Instrumentation, Applications, fluorescent indicators, study of pharmaceutically important compounds estimated by fluorimetry.

b. **Flame Photometry:** Theory, nebulisation, flame and flame temperature, interferences, flame spectrometric techniques and instrumentation and pharmaceutical applications.

b. Atomic Absorption Spectrometry: Introduction, Theory, types of electrodes, instrumentation and applications.

b. **Atomic Emission Spectroscopy**: Spectroscopic sources, atomic emission spectrometers, photographic and photoelectric detection.

b. **NMR & ESR (introduction only):** Introduction, theoretical aspects and applications.

b. **Mass Spectroscopy: (Introduction only)** – Fragmentation, types of ions produced mass spectrum and applications.

b. **Polarimetry: (Introduction only) –** Introduction to optical rotatory dispersion, circular dichroism, polarimeter.

b. **X-RAY Diffraction:** (Introduction only) – Theory, reciprocal lattice concept, diffraction patterns and applications.

b. **Thermal Analysis:** Introduction, instrumentation, applications, and DSC and DTA.

Text Books:

1. Text Book of Chemical Analysis, by A.I.Vogel, ELBS with Macmillan press, Hampshire.

2. Text Book of Pharm. Analysis by Higuchi. T and Hasen. E. B., New York Inter Science Publishers.

Reference Books:

1. Quantitative Pharma. Analysis by Jenkins, The Blakiston division, New York.

2. Instrumental Analysis by Willard and Merritt, EWP, East West Press Ltd., Delhi/Madras.

Web Links:

W1: https://www.smithers.com/services/testing/test-capabilities/chemistry/chromatography-and-spectrometry

W2: https://ebooks.inflibnet.ac.in/esp16/chapter/atomic

W3: https://ijcrt.org/papers/IJCRT2402410.pdf

W4: https://basu.org.in/wp-content/uploads/2021/01/6th-ppt-on-QMS-ISO-9000.pdf

W5: https://www.ijsred.com/volume8/issue5/IJSRED-V8I5P19.pdf

PHARMACEUTICAL ANALYSIS PRACTICAL

Subject Code: 2516PY29
Course Objectives: Upon completion of the course, the student shall be able to

COB1: Understand the chromatographic separation and analysis of drugs.
COB2: Understand the principles of volumetric and electro chemical analysis
COB3: Understand the interaction of matter with electromagnetic radiations and its applications in drug.
COB4: Provide exposure to modern analytical instrumentation, including GC-MS, DSC, flame photometry, and demonstrate their pharmaceutical applications.
COB5: Impart knowledge on spectroscopic techniques (IR, NMR, polarimetry) and their applications.
COB6: Understand simultaneous drug estimation, stability analysis, and validation principles.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Identify the mixture of sample components by Paper chromatography and TLC and interpretation of chromatograms
CO2: Analyse the compounds by various spectroscopic instruments like spectrophotometers, fluorimeters, flame photometer
CO3: Determine conductometric and potentiometric titrations of mixture of acids and bases
CO4: Demonstrate the working and analyzing compounds by HPLC, HPTLC instruments
CO5: Develop the working and analyzing compounds by , GC-MS, DSC instruments
CO6: Justify IR and NMR Spectra

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3			2		2	3	3	1	1	3
CO2	3			2		2	3	3	1	1	3
CO3	3			2		2	3	3	1	1	3
CO4	3			2		2	3	3	1	1	3
CO5	3			2		2	3	3	1	1	3
CO6	3			2		2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	2	3
CO3	2	3
CO4	3	3
CO5	3	3
CO6	2	3

Lecture wise Programme: **3 Hrs/Week**

LIST OF EXPERIMENTS:

Expt. N	Title	COs
1	Separation and identification of Amino Acids by Paper Chromatography.	**CO1**
2	Separation and identification of Sulpha drugs by TLC technique.	**CO1**
3	Effect of pH and solvent on the UV spectrum of given compound.	**CO2**
4	Comparison of the UV spectrum of a compound with that of its derivatives.	**CO2**
5	Determination of dissociation constant of indicators using UV-Visible spectroscopy.	**CO2**
6	Conductometric titration of mixture of acids with a strong base.	**CO2**
7	Potentiometric titration of a acid with a strong base.	**CO2**
8	Estimation of drugs by Fluorimetric technique.	**CO3**
9	Study of quenching effect in fluorimetry.	**CO3**
10	Colourimetric estimation of Supha drugs using BMR reagent.	**CO3**
11	Simultaneous estimation of two drugs present in given formulation.	**CO3**
12	Assay of Salicylic Acid by colourimetry.	**CO4**
13	Determination of Chlorides and Sulphates in Calcium gluconate by Nephlo turbidimetric Method.	**CO4**
14	Determination of Na/K by Flame Photometry.	**CO4**
15	Determination of pKa using pH meter.	**CO4**
16	Determination of specific rotation.	**CO5**
17	Comparison of the IR spectrum of a compound with that of its derivatives.	**CO5**
18	Demonstration of HPLC.	**CO5**
19	Demonstration of HPTLC.	**CO5**
20	Demonstration of GC-MS.	**CO6**
21	Demonstration of DSC.	**CO6**
22	Interpretation of NMR spectra of any one compound.	**CO6**

Text Books:

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers' medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York

Reference Books:

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology(vol1 and 2) by Dr. C.C. Chatterrje, Academic Publishers Kolkatas

Web Links:

W1: https://pharmaknowledgeforum.com/analytical-techniques/
W2:https://www.ijpsjournal.com/assetsbackoffice/uploads/article/Analytical+Techniques+in+Pharmaceutical+Analysis++.pdf
W3: https://egyankosh.ac.in/bitstream/123456789/43276/1/Exp-3.pdf
W4: https://chem.pg.edu.pl/documents/175260/14212622/chf_epm_lab_1.pdf
W5:https://www.biologydiscussion.com/amino-acids/separation-of-amino-acids-by-paper-chromatography-with-diagram/18003

PHARMACOTHERAPEUTICS – II (THEORY)

Subject code : 2516PY24

Course Objectives: Upon completion of the subject student shall be able to –

COB 1: understand the pathophysiology of common diseases and their management.

COB2: name the signs and symptoms and treatment of the diseases; and

COB3; mention the complications and pathophysiology of the diseases.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Know the pathophysiology of selected disease states and the rationale for drug therapy

CO2. know the therapeutic approach to management of these diseases;

CO3: know the controversies in drug therapy;

CO4: know the importance of preparation of individualized therapeutic plans based on diagnosis; and

CO5: monitoring therapy for patient comfort

CO6: appreciate the needs to identify the patient-specific parameters relevant in initiating drug therapy

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	1	2	2	1	2	2	1	2
CO2	3	1	2	1	2	3	1	2	1	1	2
CO3	3	1	2	1	2	2	1	2	2	1	2
CO4	3	1	2	1	2	2	1	2	3	1	2
CO5	3	1	2	1	2	2	1	2	2	1	2
CO6	3	1	2	1	2	2	1	2	2	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	2	3
CO5	2	3
CO6	3	3

Lecture wise Programme: **3 Hrs/Week**

Etiopathogenesis and pharmacotherapy of diseases associated with following systems / diseases

Title of the topic:

1. **Infectious disease:** Guidelines for the rational use of antibiotics and surgical Prophylaxis, Tuberculosis, Meningitis, Respiratory tract infections, Gastroenteritis, Endocarditis, Septicemia, Urinary tract infections, Protozoal infection- Malaria, HIV & Opportunistic infections, Fungal infections, Viral infections, Gonarrhoea and Syphillis
2. **Musculoskeletal disorders:** Rheumatoid arthritis, Osteoarthritis, Gout, Spondylitis, Systemic lupus erythematosus.
3. **Renal system :**Acute Renal Failure, Chronic Renal Failure, Renal Dialysis, Drug induced renal disorders
4. **Oncology:** Basic principles of Cancer therapy, General introduction to cancer chemotherapeutic agents, Chemotherapy of breast cancer, leukemia. Management of chemotherapy nausea and emesis
5. **Dermatology:** Psoriasis, Scabies, Eczema, Impetigo

Text Books:

1. Clinical Pharmacy and Therapeutics - Roger and Walker, Churchill Livingstone publication
2. Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda-Kimble MA]

Reference books:

1. Pharmacotherapy: A Pathophysiologic approach - Joseph T. Dipiro et al. Appleton & Lange
2. Clinical Pharmacy and Therapeutics - Eric T. Herfindal, Williams and Wilkins Publication

Web links:

W1: https://my.clevelandclinic.org/health/diseases/16957-endocarditis
W2: https://www.webmd.com/arthritis/about-inflammation
W3: https://versusarthritis.org/about-arthritis/conditions/gout/
W4: https://www.cancer.org/cancer/understanding-cancer/what-is-cancer.html
W5: https://www.mayoclinic.org/diseases-conditions/psoriasis/symptoms-causes/syc-20355840

PHARMACOTHERAPEUTICS – II (Practical)

Course code : 2516PY30

Course Objectives: Upon completion of the subject student shall be able to –

COB 1: understand the pathophysiology of common diseases and their management.

COB2: name the signs and symptoms and treatment of the diseases; and

COB3; mention the complications and pathophysiology of the diseases.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Know the pathophysiology of selected disease states and the rationale for drug therapy

CO2. Know the therapeutic approach to management of these diseases;

CO3: know the controversies in drug therapy;

CO4: know the importance of preparation of individualized therapeutic plans based on diagnosis;

CO5: monitoring therapy for patient comfort

CO6: appreciate the needs to identify the patient-specific parameters relevant in initiating drug therapy

Mapping of Course Outcomes with Program Outcomes

CO	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1
CO1	3	1	2	1	2	2	1	2	2	1	2
CO2	3	1	2	1	2	3	1	2	1	1	2
CO3	3	1	2	1	2	2	1	2	2	1	2
CO4	3	1	2	1	2	2	1	2	3	1	2
CO5	3	1	2	1	2	2	1	2	2	1	2
CO6	3	1	2	1	2	2	1	2	2	1	2
Average	3	1	2	3	1	2	1.1	2	2	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	2	3
CO3	3	3
CO4	2	2
CO5	3	3
CO6	3	2

Lecture wise Programme: **3 Hrs/Week**

1 Basic principles of cell injury and Adaptation

a) Causes, Pathogenesis and morphology of cell injury b) Abnormalities in lipoproteinaemia, glycogen infiltration and glycogen infiltration and glycogen infiltration and glycogen storage diseases

2 Inflammation

a) Pathogenesis of acute inflammation, Chemical mediators in inflammation, Types of chronic inflammation b) Repairs of wounds in the skin, factors influencing healing of wounds

3 Diseases of Immunity

a) Introduction to Tand B cells b) MHC proteins or transplantation antigens c) Immune tolerance - Hypersensitivity Hypersensitivity type I, II, III, IV, Biological significance, Allergy due to food, chemicals and drugs - Autoimmunity Criteria for autoimmunity, Classifications of autoimmune diseases in man, mechanism of autoimmunity, Transplantation and immunologic tolerance, allograft rejections, transplantation antigens, mechanism of rejection of allograft. - Acquired immune deficiency syndrome (AIDS),amylodosis

4 Cancer:

differences between benign and malignant tumors, Histological diagnosis of malignancy, invasions and metastasis, patterns of spread, disturbances of growth of cells, classification of tumors, general biology of tumors, spread of malignant tumors, etiology and pathogenesis of cancer

5 Types of shock, mechanisms, stages and management

6 Biological effects of radiation

7 Environmental and nutritional diseases

i) Air pollution and smoking- SO2,NO, NO2, and CO ii) Protein calorie malnutrition, vitamins, obesity, pathogenesis of starvation.

8 Pathophysiology of common diseases

a. Parkinsonism b. Schizophrenia c. Depression and mania d. Hypertension, e. Stroke (ischaemic and hemorrhage) f. Angina, CCF, Atherosclerosis, Myocardial infarction g. Diabetes Mellitus h. Peptic ulcer and inflammatory bowel diseases i. Cirrhosis and Alcoholic liver diseases j. Acute and chronic renal failure k. Asthma and chronic obstructive airway diseases

9 Infectious diseases :

Sexually transmitted diseases (HIV,Syphilis,Gonorrhea), Urinary tract infections, Pneumonia, Typhoid, Tuberculosis, Leprosy, Malaria Dysentery (bacterial and amoebic), Hepatitis-infective hepatitis.

Text Books:

1. Pathologic basis of disease by- Cotran, Kumar, Robbins.

2. Text book of Pathology- Harsh Mohan

Reference books:

1. Clinical Pharmacy and Therapeutics; Second edition; Roger Walker; ChurchillLivingstone publication
2. Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda-Kimble MA]

Web links:

W1: https://my.clevelandclinic.org/health/diseases/12194-cancer

W2: https://www.webmd.com/arthritis/about-inflammation

W3: https://www.slideshare.net/slideshow/biological-effects-of-radiation-132402641/132402641

W4: https://www.mayoclinic.org/diseases-conditions/parkinsons-disease/symptoms-causes/syc-20376055

W5: https://www.msdmanuals.com/home/hormonal-and-metabolic-disorders/diabetes-mellitus-dm-and-disorders-of-blood-sugar-metabolism/diabetes-mellitus-dm

PHARMACEUTICAL JURISPRUDENCE-THEORY

Course Code: 2516PY25

Course Objectives: Upon completion ofthe subject student shall be able

COB1: practice the Professional ethics; understand the various concepts of the pharmaceutical legislation in India.

COB2: know the various parameters in the Drug and Cosmetic Act and rules; know the Drug policy, DPCO, Patent and design act.

COB3: understand the labeling requirements and packaging guidelines for drugs and cosmetics.

COB4: be able to understand the concepts of Dangerous Drugs Act, Pharmacy Act and Excise duties Act; and other laws as prescribed by the Pharmacy Council of India from time to time including International Laws.

Course Outcomes: At the end of the course, the student will be able to:

CO1: The Professional ethics and to understand the various concepts of the pharmaceutical legislation in India.

CO2: The various parameters in the Drug and Cosmetic Act and rules and to understand the functions various officers comes under D &C act , labeling requirements and packaging guidelines for drugs and cosmetics

CO3: The various rules and educational regulations, constitution &functions of PCI as well as registration process for pharmacist described under Pharmacy act

CO4: The various parameters, construction , design of bonded and non-bonded laboratory manufacturing, warehousing and storage procedure for alcoholic and non alcoholic in mentioned under medicinal and toilet preparation act

CO5: About Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and regulations

CO6: The knowledge on prohibited and exempted classes of advertisements relating drugs and magic remedies described under act (Drug policy, DPCO, Patent and design act, Understand the procedure for experimentation , breeding and stocking of animals under the Prevention Of Cruelty to animals Act.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3				2	3	3		2		2
CO 2	3			1	2	2	2		2		2
CO 3	2			1	2		2		2		2
CO 4	2			1	2		2		2		2
CO 5	2			1	2		2		2		2
CO 6	3			1	2		2		2		2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	2
CO3	1	1
CO4	2	1
CO5	2	2
CO6	2	1

Lecture wise Programme: **2 Hrs/Week**

1. Pharmaceutical Legislations – A brief review.
2. Principle and Significance of professional ethics. Critical study of the code of pharmaceutical ethics drafted by PCI.
3. Drugs and Cosmetics Act, 1940, and its rules 1945.

Objectives, Legal definition, Study of Schedule's with reference to Schedule B, C&C1, D, E1, F&F1, F2, F3, FF, G, H, J, K, M, N, P, R, V, W, X, and Y.

Sales, Import, labelling and packaging of Drugs and Cosmetics Provisions Relating to Indigenous Systems Constitution and Functions of DTAB, DCC, and CD. Qualification and duties –Govt. analyst and Drugs Inspector.

4. **Pharmacy Act –1948**.

Objectives Legal Definitions, General Study, Constitution and Functions of State & Central Council, Registration & Procedure, and ER.

5. **Medicinal and Toilet Preparation Act –1955**.

Objectives, Legal Definitions, Licensing, Bonded and Non-Bonded Laboratory, Ware Housing, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations

6. **Narcotic Drugs and Psychotropic substances Act-1985 and Rules**. Objectives, Legal Definitions, General Study, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and regulations, and Schedules to the Act.
7. **Study of Salient Features of Drugs and magic remedies Act and its rules.**
8. **Study of essential Commodities Act Relevant to drugs price control Order**
9. **Drug Price control Order & National Drug Policy (Current).**
10. **Prevention of Cruelty to animals Act-1960.**
11. **Patents & design Act-1970.**
12. **Brief study of prescription and Non-prescription Products.**

Text Books:

1. Forensic Pharmacy by B. Suresh
2. Text book of Forensic Pharmacy by B.M. Mithal

Reference books:

1. Singh, KK, editor. Beotra's the Laws of Drugs, Medicines & cosmetics. Allahabad: Law Book House; 1984.

2. Jain, NK. A Textbook of forensic pharmacy. Delhi: Vallabh prakashan ; 1995.

3. Reports of the Pharmaceutical enquiry Committee

Website links :

W1: **https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/non-prescription-drug**
W2: **https://ipindia.gov.in/writereaddata/Portal/IPOAct/1_31_1_patent-act-1970-11march2015.pdf**
W3: **https://dahd.nic.in/prevention-cruelty-animals-act-1960**
W4: **https://www.sciencedirect.com/science/article/abs/pii/S2214420X15000480**
W5: **https://ipapharma.org/code-of-pharmaceutical-ethics/**

MEDICINAL CHEMISTRY (Theory)

Subject Code: 2516PY26

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

COB1: Understand the chemistry of drugs with respect to their pharmacological activity

COB2: Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs

COB3: Know the Structural Activity Relationship of different class of drugs

COB4: Study the chemical synthesis of selected drugs

Course Outcomes: At the end of the course, the student will be able to:

CO1: Interpret the chemistry of drugs with respect to their pharmacological activity, the drug metabolic pathways, adverse effect and therapeutic value of drugs

CO2: Explain the importance of drug design and different techniques of drug design and the principles of metabolism, adverse effects and therapeutic value of drugs

CO3: Interpret the Structural Activity Relationship (SAR) of different class of drugs

CO4: Synthesize the chemical synthesis of drugs and intermediates, and reaction conditions

CO5: Prepare the green chemistry techniques involved in the preparation of synthetic compounds

CO6: Describe the compound workout techniques, and purification techniques, the application of TLC techniques for product conformation and purification.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3			2		2	3	3	1	1	3
CO2	3			2		2	3	3	1	1	3
CO3	3			2		2	3	3	1	1	3
CO4	3			2		2	3	3	1	1	3
CO5	3			2		2	3	3	1	1	3
CO6	3			2		2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	3
CO2	3	3
CO3	3	2
CO4	2	1
CO5	2	1
CO6	2	2

Lecture wise Programme: **3 Hrs/Week**

1. Modern concept of rational drug design: A brief introduction to Quantitative Structure Activity Relationship (QSAR), prodrug, combinatorial chemistry and computer aided drug design (CADD) and concept of antisense molecules.

A study of the development of the following classes of drugs including SAR, mechanism of action, synthesis of important compounds, chemical nomenclature, brand names of important marketed products and their side effects.

1. Anti-infective agents
a. Local anti-infective agents
b. Preservatives
c. Antifungal agents
d. Urinary tract anti-infectives
e. Antitubercular agents
f. Antiviral agents and Anti AIDS agents
g. Antiprotozoal agents
h. Anthelmentics
i. Antiscabies and Antipedicular agents
2. Sulphonamides and sulphones
3. Antimalarials
4. Antibiotics
5. Antineoplastic agents
6. Cardiovascular agents
a. Antihypertensive agents
b. Antianginal agents and vasodilators
c. Antiarrhythmic agents
d. Antihyperlipidemic agents
e. Coagulants and Anticoagulants
f. Endocrine
7. Hypoglycemic agents
8. Thyroid and Antithyroid agents
9. Diureties
10. Diagnostic agents
11. Steroidal Hormones and Adrenocorticoids

Text Books:

1. Wilson and Gisvold's Text book of Organic, Medicinal and Pharmaceutical Chemistry, Lippincott-Raven Publishers-New York, Philadelphia.
2. William.O.Foye, Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd., New Delhi.

Reference Books:

1. Burgers, Medicinal Chemistry, M.E.,Welly Med.Chemistry M.E. Walffed Johnwilley and Sons, Wiley-interscience Publication, New York, Toranto.
2. A Text Book of Medicinal Chemistry Vol. I and II by Surendra N. Pandeya,
3. S.G. Publisher, 6, Dildayal Nagar, Varanasi -10.

Website Links:

W1: https://pharmacyinfoline.com/medicinal-chemistry-pharm-d/

W2:https://pharmanotes.org/2022/02/local-anti-infective-agents-and-preservatives-medicinal-chemistry-iii-b-pharma-6th-semester/

W3:https://pharmacyconcepts.in/wp-content/uploads/2022/05/Sulfonamide-and-Sulfone.pdf

W4:https://www.sip.sal.edu.in/PharmD-syllabus/Year-3/Medicinal%20Chemistry.pdf

W5:https://www.lastbenchpharmacist.in/post/pharm-d-3rd-year-medicinal-chemistry-pdf-notes/

MEDICINAL CHEMISTRY (Practical)

Course Code: 2516PY31

Course Objectives: Upon completion of the subject student shall be able to

COB1: Understand the chemistry of drugs with respect to their pharmacological activity

COB2: Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs

COB3: Know the Structural Activity Relationship of different class of drugs

COB4: Study the chemical synthesis of selected drugs

Course Outcomes: At the end of the course, the student will be able to:

CO1: Perform the assays of important drugs from the course content

CO2: Preparation of medicinally important compounds or intermediates required for synthesis of drugs

CO3: Preparation of medicinally important compounds or intermediates required for synthesis of drugs

CO4: Identification important drugs

CO5: Identification important drugs

CO6: Determination of dissociation constants and molar refractivity of compounds for QSAR analysis

Mapping of Course Outcomes with Program Outcomes:

CO/PO	P O1	P O2	P O3	PO 4	P O5	P O6	P O7	P O8	PO 9	PO 10	PO 11
CO 1	3		2	1				2		2	3
CO 2	3		1					1		2	3
CO 3	3		2					1		2	3
CO 4	3		2					1		1	2
CO 5	3		2	1				1		1	2
CO 6	3		2	1				1			2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	3
CO2	2	1
CO3	2	1
CO4	3	2
CO5	3	2
CO6	2	2

Lecture wise Programme: **3 Hrs/Week**

List of Experiments:

Expt. No	Title	CO'S
1	Preparation of Benzocaine	CO2
2	Preparation of 7-Hydroxy-4-Methyl Coumarine	CO2
3	Preparation of Benzimidazole	CO2
4	Preparation of Benztriazole	CO2
5	Preparation of Benzilic Acid	CO3
6	Preparation of Flourescein	CO3
7	Preparation of 5,5- Diphenyl Hydantoin	CO3
8	Preparation of 2,3- Diphenyl Quinoxaline	CO3
9	Identification of Sulphonamide	CO4
10	Identification of Isoniazid	CO4
11	Identification of Metronidazole	CO5
12	Identification of Ascorbic Acid	CO5
13	Identification of Benzocaine	CO5
14	Assay of Ascorbic Acid	CO1
15	Assay of Chloroquine Phosphate	CO1
16	Assay of Isoniazid	CO1
17	Assay of Benzocaine	CO1
18	Assay of Metronodazole	CO1
19	Assay of Sulphonilamide	CO1
20	Assay of Diclofenac Sodium	CO1
21	Assay of Dapsone	CO1
22	Qsar Studies	CO6

Text books:

1. Wilsonand Gisvold's Textbook of Organic, Medicinal and Pharmaceutical Chemistry, Lippincott-Raven Publishers-NewYork, Philadelphia.
2. William.O.Foye, Principles of Medicinal Chemistry, B.I.Waverly Pvt. Ltd., NewDelhi.

Reference Books

1. Burgers, Medicinal Chemistry, M.E.,Welly Med.Chemistry M.E.Walffed John willey and Sons, Wiley-interscience Publication, NewYork, Toranto.
2. A Text Book of Medicinal Chemistry Vol. I and II by Surendra N. Pandeya,
3. S. G. Publisher, 6, Dildayal Nagar, Varanasi-10

Website links:

W1: https://mlrip.ac.in/wp-content/uploads/2022/03/MEDICINAL-CHEMISTRY-III-LAB-MANUAL.pdf

W2: https://www.sciencedirect.com/science/article/abs/pii/S1350417710001732

W3:https://www.researchgate.net/publication/341821250_Synthesis_of_Benzil_and_its_Various_Derivatives

W4: https://www.studocu.com/en-us/document/creighton-university/pharmaceutics-regulatory-affairs/experiment-567-8-nnn/96529611

W5: https://www.scribd.com/document/557415720/assay-chloroquine

PHARMACEUTICAL FORMULATIONS – THEORY

Course Code: 2516PY27

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

COB1: To develop a comprehensive understanding of pharmaceutical dosage forms, including their key concepts and classifications, setting the groundwork for advanced studies in formulation and manufacturing.

COB2: To master the formulation of diverse tablet types, explore tablet excipients and granulation techniques, and gain proficiency in tablet coating. Acquire in-depth knowledge of quality control tests for both coated and uncoated tablets.

COB3: To acquire expertise in the production and filling of hard gelatin capsules, including the selection of raw materials and stringent quality control tests. Explore the intricacies of producing, filling, and evaluating soft gelatin capsules.

COB4: Formulate and evaluate various liquid oral preparations, such as suspensions, emulsions, and solutions. Investigate the stability considerations associated with these formulations.

COB5: To gain insight into parenteral formulations, encompassing large and small volume preparations. Understand the meticulous selection of containers, official tests, and the critical process of sterilization.

COB6: To conceptualize and define controlled and novel drug delivery systems, with examples such as parenteral, transdermal, buccal, rectal, nasal, implants, and ocular systems. Examine the advantages and challenges associated with these advanced delivery methods.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Memorize the definition and basic characteristics of dosage forms used in pharmaceutical formulations

CO2: Demonstrate the application of granulation techniques in tablet manufacturing, considering the properties of the active ingredient and the desired tablet characteristics.

CO3: Design a comprehensive quality control plan for capsule manufacturing, incorporating various tests to ensure product integrity and compliance.

CO4: Explain the essential features of emulsions, suspensions, and solutions as liquid oral dosage forms.

CO5: Critically assess the quality control measures used to ensure the safety and efficacy of parenteral products.

CO6: Memorize the key factors that can affect the absorption of drugs, and the basic anatomy of the skin & Demonstrate the application of concepts in designing drug delivery systems for transdermal, buccal, rectal, nasal, implants, and ocular route.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1					3		3	1	3
CO2	3	3	2		1	1	3			1	3
CO3	3	2	2	1			3			1	3
CO4	3			3			3				3
CO5	3	1	1		1		3	3	2	2	3
CO6	3	1				1	3	1			3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	1
CO2	3	2
CO3	3	3
CO4	2	1
CO5	2	3
CO6	3	2

Lecture wise Programme **2 Hrs. /Week**

1. Pharmaceutical dosage form- concept and classification
2. Tablets: Formulation of different types of tablets, tablet excipients, granulation techniques - quality control and evaluation of tablets. Tablet coating, Type of coating, quality control tests for coated tablet.
3. Capsules; Production and filling of hard gelatin capsules, Raw material for shell, finishing, quality control tests for capsules. Production and filling of soft gelatin capsules, quality control tests for soft gelatin capsules.
4. Liquid orals: Formulation and evaluation of suspensions, emulsions and solutions. Stability of these preparations
5. Parenterals: Introduction, Containers used for Parenterals (including official tests), Formulation of large and small volume Parenterals, and Sterilization.
6. Ophthalmic preparations (Semi – Solids): Introduction and classification, Factors affecting absorption and anatomy of skin, Packaging storage and labeling,
Ointments: Types of Ointment Base, Preparation of ointment, Jellies: Types of jellies Formulation of jellies Suppositories: Method of preparation, andTypes Packaging
7. Definition and concept of Controlled and novel Drug delivery systems with available examples, viz. parentral, trans dermal, buccal, rectal, nasal, implants, and ocular.

Text books

1. Pharmaceutical dosage forms, Vol, I,II and III by lachman
2. Rowlings Text book of Pharmaceutics

Reference books

1. Remington's Pharmaceutical Sciences
2. USP/BP/IP
3. Tutorial Pharmacy – Cooper &Gun

Weblinks

W1 ; https://www.pharmaguideline.com/2021/08/introduction-classification-dosage-forms.html

W2 ; https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/parenteral-solution

W3 ; https://pharmdguru.com/ophthalmic-preparations-semi-solids/#google_vignette

W4; https://www.ijpsjournal.com/article/Review+Article+on+Novel+Drug+Delivery+Syste m

W5; https://www.nelsonlabs.com/testing/packaging-liquid-oral-dosage-forms/

PHARMACEUTICAL FORMULATIONS PRACTICAL

Course Code: 2516PY32

Course Objectives: Upon completion of the course the student shall be

COB1: To learn and implement the wet granulation technique for the production of ordinary compressed tablets, understanding the process and its impact on tablet characteristics.

COB2: To master the direct compression method for tablet preparation, emphasizing the efficiency and simplicity of this technique.

COB3: To formulate soluble and chewable tablets, focusing on creating pharmaceutical dosage forms tailored for specific patient needs and preferences.

COB4: To understand the formulation and filling process for hard gelatin capsules, emphasizing precision and quality control in pharmaceutical manufacturing.

COB5: To perform Quality Control (QC) tests on tablets, capsules, and injections to assess their compliance with established standards and ensure product quality.

COB6: To formulate two liquid oral preparations (Paracetamol Syrup and Aluminum hydroxide gel) and evaluate their potency through assay methods, emphasizing accuracy in formulation.

Course Outcome: At the end of the course, the student will be able to:

CO1: Evaluate and troubleshoot common issues encountered during tablet manufacturing processes.

CO2: Explain the significance of selecting appropriate powders and granules for encapsulation

CO3: Recall the basic categories of formulation components for parenteral products, including excipients, solubilizers, and stabilizers.

CO4: Evaluation of parenterals

CO5: Develop two comprehensive formulations for distinct liquid oral preparations, considering solubility, stability, and palatability.

CO6: Demonstrate the ability to select appropriate bases and additives based on the desired properties of the semi-solid product & Explain the basic principles governing theformulation of cosmetic preparations

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1					3		3	1	3
CO2	3	3	2		1	1	3			1	3
CO3	3	2	2	1			3			1	3
CO4	3			3			3				3
CO5	3	1	1		1		3	3	2	2	3
CO6	3	1				1	3	1			3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	1	2
CO4	1	3
CO5	3	2
CO6	3	1

Lecture wise Programme: **3 Hrs/Week**

List of Experiments

Experiment number.	Title of the experiment	CO
1	Manufacture of Tablets Ordinary compressed tablet-wet granulation Tablets prepared by direct compression. Soluble tablet. Chewable tablet.	**CO1**
2	Formulation and filling of hard gelatin capsules	**CO1**
3	Manufacture of parenterals Ascorbic acid injection Calcium gluconate injection Sodium chloride infusion. Dextrose and Sodium chloride injection/ infusion	**CO2**

4	Evaluation of Pharmaceutical formulations (QC tests) Tablets Capsules Injections	**CO3**
5	Formulation of two liquid oral preparations and evaluation by assay Solution: Paracetamol Syrup Antacid suspensions- Aluminum hydroxide gel	**CO4**
6	Formulation of semisolids and evaluation by assay Salicyclic acid and benzoic acid ointment Gel formulation Diclofenac gel	**CO5**
7	Cosmetic preparations Lipsticks Cold cream and vanishing cream Clear liquid shampoo Tooth paste and tooth powders	**CO6**
8	Tablet coating (demonstration)	**CO1**

Text books

1. Pharmaceutical dosage forms, Vol, I,II and III by lachman
2. Rowlings Text book of Pharmaceutics

Reference books

1. Remington's Pharmaceutical Sciences
2. USP/BP/IP
3. Tutorial Pharmacy – Cooper &Gun

Weblinks

W1; https://www.drugs.com/pro/dextrose-and-sodium-chloride-injection.html

W2: https://www.researchgate.net/publication/325023106_Textbook_of_Cosmetic_Formulations

W3: https://www.researchgate.net/publication/344955531_CAPSULES_TYPES_MANUFACTURING_FORMULATION_QUALITY_CONTROL_TESTS_AND_PACKAGING_AND_STORAGE_-_A_COMPREHENSIVE_REVIEW

W4: https://rjptonline.org/HTMLPaper.aspx?Journal=Research%20Journal%20of%20Pharmacy%20and%20Technology;PID=2011-4-9-2

W5: https://patents.google.com/patent/CN103961312A/en

4th YEAR

PHARMACOTHERAPEUTICS-III (THEORY)

Subject Code: 2516PY33

Course Objectives: Upon the completion of the course completion of this subject it is expected that students will be able to understand

COB1: The pathophysiology of selected disease states and the rationale for drug therapy;

COB2: The therapeutic approach to management of these diseases;

COB3: The controversies in drug therapy;

COB4: The importance of preparation of individualized therapeutic plans based on diagnosis;

COB5: Needs to identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time-course of clinical and laboratory indices of therapeutic response and adverse effects);

COB6: Describe the pathophysiology of selected disease states and explain the rationale for drug therapy;

Course Outcomes : At the end of the course, the student will be able to:

CO1 : Identify drug interactions and rationalize the prescription (Remember)

CO2 : Discuss the therapeutic approach to management of selected diseases (Understand)

CO3 : Calculate individualized therapeutic plans based on diagnosis(Apply)

CO4 : Show patient counseling(Apply)

CO5 : Arrange planned experiments and prepare laboratory report in a standard format(Remember)

CO6 : Identify the controversies in drug therapy(Remember)

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3		2	1							3
CO2	3		2	1							2
CO3	3		2	1		2		2			2
CO4	3		2	1				2	3	2	2
CO5	3		2	1				1	2		2
CO6	3	2	1		2		1.6	2.5	2	2.2	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	2
CO4	2	2
CO5	2	2
CO6	2	3

Lecture wise Programme: **3 Hrs/Week**

Unit1:

Gastrointestinal system: Peptic ulcer disease, Gastro Esophageal Reflux Disease, Inflammatory bowel disease, Liver disorders - Alcoholic liver disease, Viral hepatitis including jaundice, and Drug induced liver disorders.

Unit2:

Hematological system: Anemia's, Venous thromboembolism, Drug induced blood disorders.

Unit 3:

Nervous system: Epilepsy, Parkinsonism, Stroke, Alzheimer's disease**.**

Unit 4:

Psychiatry disorders: Schizophrenia, Affective disorders, Anxiety disorders, Sleep disorders, Obsessive Compulsive disorders

Unit 5:

Pain management including Pain pathways, neuralgias, headaches.

Unit 6:

Evidence Based Medicine

Text Books

1. Clinical Pharmacy and Therapeutics - Roger and Walker, Churchill Livingstone publication
2. Pharmacotherapy: A Pathophysiologic approach - Joseph T. Dipiro et al. Appeton & Lange

Reference Books

1. Pathologic basis of disease - Robins SL, W.B.Saunders publication
2. Pathology and therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice -Green and Harris, Chapman and Hall publication
3. Clinical Pharmacy and Therapeutics - Eric T. Herfindal, Williams and Wilkins Publication.

Web Links :

W1: Roger-Walker-Clinical-Pharmacy-and-Therapeutics-5th-Ed..pdf-GoogleDrive

W2:DiPiro'sPharmacotherapy:APathophysiologicApproach,12thEdition|AccessPharmacy|McGrawHillMedical(mhmedical.co m)

W3: https://www.pharmacyinfoline.com/pharm-d-syllabus/pharm-d-year-wise- subjects/pharm-d-4th-year/pharmacotherapeutics-iii/

W4: https://www.scribd.com/document/693465268/PHARMACOTHERAPEUTICS-III-FOURTH-PHARM-D

W5: https://pharmdguru.com/category/pharmacotherapeutics-3/

PHARMACOTHERAPEUTICS-III (PRACTICAL)

Subject Code: 2516PY39

Course Objectives: Upon the completion of the course completion of this subject it is expected that students will be able to understand

COB1: The pathophysiology of selected disease states and the rationale for drug therapy;

COB2: The therapeutic approach to management of these diseases;

COB3: The controversies in drug therapy;

COB4: The importance of preparation of individualized therapeutic plans based on diagnosis;

COB5: Needs to identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time-course of clinical and laboratory indices of therapeutic response and adverse effects);

COB6: Describe the pathophysiology of selected disease states and explain the rationale for drug therapy;

Course Outcomes : At the end of the course, the student will be able to:

CO1: Identify drug interactions and rationalize the prescription

CO2: Discuss the therapeutic approach to management of selected diseases

CO3: Calculate individualized therapeutic plans based on diagnosis

CO4: Show patient counseling

CO5: Arrange planned experiments and prepare laboratory report in a standard format

CO6: Identify the controversies in drug therapy

Mapping of Course Outcomes with Program Outcomes

CO/ PO	PO 1	PO2	PO3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1
CO1	3		2	1							3
CO2	3		2	1							2
CO3	3		2	1		2		2			2
CO4	3		2	1				2	3	2	2
CO5	3		2	1				1	2		2
CO6	3	2	1		2		1.6	2.5	2	2.2	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	2
CO4	2	2
CO5	2	2
CO6	2	3

Lecture wise Programme: **3 Hrs/Week**

Unit1:

Gastrointestinal system: Peptic ulcer disease, Gastro Esophageal Reflux Disease, Inflammatory bowel disease, Liver disorders - Alcoholic liver disease, Viral hepatitis including jaundice, and Drug induced liver disorders.

Unit2:

Hematological system: Anemia's, Venous thromboembolism, Drug induced blood disorders.

Unit 3:

Nervous system: Epilepsy, Parkinsonism, Stroke, Alzheimer's disease**.**

Unit4:

Psychiatry disorders: Schizophrenia, Affective disorders, Anxiety disorders, Sleep disorders, Obsessive Compulsive disorders

Unit5:

Pain management including Pain pathways, neuralgias, headaches.

Unit6:

Evidence Based Medicine

Text Books

1. Clinical Pharmacy and Therapeutics - Roger and Walker, Churchill Livingstone publication
2. Pharmacotherapy: A Pathophysiologic approach - Joseph T. Dipiro et al. Appeton & Lange

Reference Books

1. Pathologic basis of disease - Robins SL, W.B.Saunders publication

2. Pathology and therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice -Green and Harris, Chapman and Hall publication

3. Clinical Pharmacy and Therapeutics - Eric T. Herfindal, Williams and Wilkins Publication.

Web Links:

W1: Roger-Walker-Clinical-Pharmacy-and-Therapeutics-5th-Ed..pdf-GoogleDrive

W2:DiPiro'sPharmacotherapy:APathophysiologicApproach,12thEdition|AccessPharmacy|McGrawHillMedical(mhmedical.co m)

W3:https://www.pharmacyinfoline.com/pharm-d-syllabus/pharm-d-year-wise-subjects/pharm-d-4th-year/pharmacotherapeutics-iii/

W4: https://www.vitalsource.com/products/lehne-39-s-pharmacotherapeutics-for-advanced-practice-laura-d-rosenthal-jacqueline-v9780323936798?srsltid=AfmBOooxgkwOj8ZZRElGly3JXAWNSHKD-AetvNvGQ2Lkdynp0oUKirg8&utm_source

W5: https://cardiotextpublishing.com/assorted-cardiology/cardiovascular-pharmacotherapeutics-3rd-edition?srsltid=AfmBOopvvMsX6JXOxDpIdjGqOYRiqyrebU44l3ukQfJk2K0o4HCV5iHD

HOSPITAL PHARMACY – THEORY

Course Code: 2516PY34

Course Objectives: Upon completion of the course, the student shall be able to –

COB1: Know various drug distribution methods; know the professional practice management skills in hospital pharmacies.

COB2: Provide unbiased drug information to the doctors; know the manufacturing practices of various formulations in hospital set up.

COB3: Appreciate the practice-based research methods; and appreciate the stores management and inventory control.

Course Outcomes: At the end of the course, the student will be able to:

CO1: About Hospital - its organization and functions, Hospital Pharmacy- Organization and management

CO2: The Knowledge about Budget – Preparation and implementation, Hospital drug policy.

CO3: About Hospital pharmacy services

CO4: To understand Manufacture of Pharmaceutical preparation

CO5: continuing professional development programs.

CO6: Radio Pharmaceuticals – Handling and packaging, Professional Relations and practices of hospital pharmacist

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO 9	PO10	PO11
CO 1	3	2		1	2	2	2	2	2		2
CO 2	3	2		1	2	2	2	2			2
CO 3	3	2		1	2	2	2	2	2		2
CO 4	3	2		1	2	2	2	2			2
CO 5	3	2		1	2	2	2	2	2		2
CO 6	3	2		1	2	2	2	2	2		2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	3
CO2	1	1
CO3	3	3
CO4	2	2
CO5	2	2
CO6	2	2

Lecture wise Programme: **2 Hrs/Week**

1. **Hospital -** its organization and functions

2. **Hospital pharmacy**- Organization and management

a. Organizational structure-Staff, Infrastructure & work load statistics

b. Management of materials and finance

c. Roles & responsibilities of hospital pharmacist

3. **The Budget** – Preparation and implementation

4. Hospital drug policy

a. Pharmacy and Therapeutic committee (PTC)

b. Hospital formulary

c. Hospital committees

1. Infection committee

2. Research and ethical committee

d. Developing therapeutic guidelines

e. Hospital pharmacy communication – Newsletter

5. Hospital pharmacy services

a. Procurement & warehousing of drugs and Pharmaceuticals

b. Inventory control Definition, various methods of Inventory Control ABC, VED, EOQ, Lead time, and safety stock

c. Drug distribution in the hospital

1. Individual prescription method

2. Floor stock method

3. Unit dose drug distribution method

d. Distribution of Narcotic and other controlled

substances central sterile supply services – Role

of pharmacist

6. Manufacture of Pharmaceutical preparations

a. Sterile formulations – large and small volume parenteral

b. Manufacture of Ointments, Liquids, and creams

c. Manufacturing of Tablets, granules, capsules, and powders

d. Total parenteral nutrition

7. Continuing professional development programs

Education and training

8. Radio Pharmaceuticals – Handling and packaging

9. Professional Relations and practices of hospital pharmacist

Text books:

1. Hospital pharmacy by William .E. Hassan
2. A text book of Hospital Pharmacyby S.H.Merchant & Dr. J.S. Qadry. Revised by R.K.Goyal & R.K. Parikh

Reference books:

1. WHO consultative group report.
2. R.P.S. Vol.2. Part –B; Pharmacy Practice section.
3. Handbook of pharmacy – health care. Edit. Robin J Harman. The Pharmaceutical press

WEB LINKS:

W1:

https://www.researchgate.net/publication/351343832_DEVELOPING_THERAPE

UTI C_GUID ELINES

W2: https://www.moh.gov.sa/Documents/PHARMACY-NEWSLETTER-VOLUME1-ISSUE-2-2.pdf

W3:https://annamalaiuniversity.ac.in/studport/download/engg/pharm/resources/pharmd_4Y%20&%201Y%20(PB)_4.2_hospital%20pharmacy.pdf.

W4: https://pharmdguru.com/procurement-and-warehousing-of-drugs-and-pharmaceuticals/ W5: https://share.google/hvLptfK4YEdpedVho

HOSPITAL PHARMACY- PRACTICAL

Course Code:

2516PY40 Course

Objectives:

COB1: Assessment of drug interactions in the given prescriptions

COB2: Manufacture of parenteral formulations, powders.

COB3: Drug information queries.

COB4: Inventory control

Course Outcomes:

CO1: Define Drug profile

CO2: Assessment of drug interactions in the given prescriptions

CO3: Discuss about Manufacture of parenteral formulations.

CO4: Choose Manufacture of

powders. **CO5:** List the Drug

information queries. **CO6:** Explain

the Inventory control.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	1		2	1	2	2	1			2
CO2	2	1		2	2	2	2	1	2		2
CO3	2	1		2	1	2	2	1	2		2
Co4	2	1		2	2	2	2	1	2		2
CO5	2	1		2	2	2	2	1	2		2
CO6	2	1		2	1	2	2	1	2		2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	3	2
CO3	2	3
CO4	1	1
CO5	3	2
CO6	2	2

COURSE CONTENT **3 Hrs./Week**

List of Experiments:

Expt. No	Title	CO
1	Drug profile of given drug (paracetamol)	**CO1**
2	Drug profile of given drug (Metronidazole)	**CO1**
3	Drug profile of given drug (Tramadol)	**CO1**
4	Drug profile of given drug (Ondansetron)	**CO1**
5	Identification of Drug interactions in the given case study-1	**CO2**
6	Identification of Drug interactions in the given case study-2	**CO2**
7	Identification of Drug interactions in the given case study-3	**CO2**
8	Preparation of normal saline solution	**CO3**
9	Preparation of Dextrose injection	**CO3**
10	Preparation of Mannitol injection	**CO3**
11	Preparation of Sodium chloride injection injection	**CO3**
12	Preparation of Dusting powder	**CO4**
13	Preparation of Bulk powder	**CO4**
14	Drug information Query-1	**CO5**
15	Drug information Query-2	**CO5**
16	Drug information Query-3	**CO5**
17	Inventory control introduction	**CO6**
18	Inventory control by using ABC analysis	**CO6**
19	Inventory control by using VED analysis	**CO6**
20	Inventory control by using EOQ method	**CO6**

Text books:

1. Hospital pharmacy by William .E. Hassan
2. A text book of Hospital Pharmacyby S.H.Merchant & Dr. J.S. Qadry. Revised by R.K.Goyal & R.K. Parikh

REFERENCE BOOKS:

1. Hospital pharmacy by William .E. Hassan

2. A text book of Hospital Pharmacy by Sheberghan & Dr.

J.S. Qadry. Revised By Koyal & R.K. Parikh

WEB LINKS:

W1: https://noteskarts.com/hospital-clinical-pharmacy-pdf-notes/

W2: https://pharmdguru.com/category/hospital-pharmacy/page/2/#google_vignette

W3: https://www.slideshare.net/slideshow/manufacture-of-pharmaceutical- preparations/249685061

W4: **https://pharmdguru.com/procurement-and-warehousing-of-drugs-and-pharmaceuticals/** **W5**: **https://share.google/hvLptfK4YEdpedVho**

CLINICAL PHARMACY – THEORY

Course Code: 2516PY35

Course Objectives: Upon completion of the subject student shall be able to –

COB1: Describe the etiology and pathogenesis of the selected disease states

COB2: Monitor drug therapy of patient through medication chart review and clinical review

COB3: obtain medication history interview and counsel the patients

COB4: Identify and resolve drug related problems

COB5: Detect, assess and monitor adverse drug reaction

Course Outcomes: At the end of the course, the student will be able to:

CO1 Recall the fundamental principles of clinical pharmacy theory, including the processes involved in monitoring drug therapy, obtaining medication history, and interpreting laboratory

CO 2 Describe the importance of obtaining comprehensive medication histories and providing patient counselling for effective pharmacotherapy.

CO 3 Apply knowledge and skills to identify and resolve drug-related problems, ensuring safe

CO 4 Analyze selected laboratory results within the context of specific disease states to make informed decisions regarding medication regimens.

CO 5 Evaluate the reliability and relevance of drug information sources to ensure evidence- based practice in clinical pharmacy

CO6 Explain the types of ADR'S & Drug interactions.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3			2		2	3	3	1	1	3
CO2	3			2		2	2	3	1	1	3
CO3	3			2		2	3	3	1	1	3
CO4	3			2		2	3	3	1	1	3
CO5	3			2		2	2	3	1	1	3
CO6	3			2		2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	3
CO2	3	2
CO3	3	2
CO4	2	3
CO5	2	3
CO6	3	3

Lecture wise programme **3Hrs./Week**

1. Definitions, development and scope of clinical pharmacy

2. Introduction to daily activities of a clinical pharmacist a. Drug therapy monitoring (medication chart review, clinical review, pharmacist interventions) b. Ward round participation c. Adverse drug reaction management d. Drug information and poisons information e. Medication history f. Patient counseling g. Drug utilization evaluation (DUE) and review (DUR) h. Quality assurance of clinical pharmacy services

3. Patient data analysis: The patient's case history, its structure and use in evaluation of drug therapy & Understanding common medical abbreviations and terminologies used in clinical practices.

4. Clinical laboratory tests used in the evaluation of disease states, and interpretation of test results a. Haematological, Liver function, Renal function, thyroid function tests b. Tests associated with cardiac disorders c. Fluid and electrolyte balance d. Microbiological culture sensitivity tests e. Pulmonary Function Tests

5. Drug & Poison information a. Introduction to drug information resources available b. Systematic approach in answering DI queries c. Critical evaluation of drug information and literature d. Preparation of written and verbal reports e. Establishing a Drug Information Centre
f. Poisons information- organization & information resources

6. Pharmacovigilance a. Scope, definition and aims of pharmacovigilance b. Adverse drug reactions - Classification, mechanism, predisposing factors, and causality assessment [different scales used] c. Reporting, evaluation, monitoring, preventing & management of ADRs d. Role of pharmacist in management of ADR.

7. Communication skills, including patient counselling techniques,
medication history interview, and presentation of cases.

8. Pharmaceutical care concepts

9. Critical evaluation of biomedical literature

10. Medication errors

TEXTBOOKS

1. Clinical Pharmacy and Therapeutics - Roger and Walker, Churchill Livingstone publication

2. Phaacotherapy: A Pathophysiologic approach - Joseph T. Dipiro et al. Appeton & Lange

References:

1. Pathologic basis of disease - Robins SL, W.B.Saunders publication
2. Pathology and therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice –
3. Green and Harris, Chapman and Hall publication

WEBSITES

W1:https://www.longdom.org/open-access/monitoring-drug-therapy-importance-methods- and- challenges-102274.html

W2:

https://pmc.ncbi.nlm.nih.gov/articles/PMC2723207

/ W3:

https://www.drugs.com/drug_interactions.html

W4:

https://www.medscape.com/druginfo/interaction-

checker

W5:https://www.micromedexsolutions.com/

CLINICAL PHARMACY –PRACTICAL

Course Code: 2516PY41

Course Objectives:

COB1: Assessment of drug interactions & ADR'S in the given prescriptions

COB2: Participating in Ward rounds & Patients counseling regarding with various diseases.

COB3: Monitoring parameters of kidney function tests, liver function tests, cardiac markers.

COB4: Analyses the patient medication history interviews, drug information query, & medication errors in Ward round participation

Course Outcomes: At the end of the course, the student will be able to:

CO1; Ffollow the pharmaceutical activities, integrating the theoretical knowledge & practical skills in clinical pharmacy

CO2; Assessment ofhttps://www.ashp.org/-/media/assets/pharmacy-practice/resource-centers/preceptor- toolkit/sicp-busy-day-systematic-approach-answering-drug-info-requests.pdf

CO3 Discuss about Patients medication counseling skills & understand the patient medication tools in Ward round participation.

CO4 Choose Knowledge of laboratory investigation to case studies.

CO5 List the Medication history interviews procedure & process of patient counseling & communication skills

CO6 Explain the types of ADR'S & Drug interactions.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3			2		2	3	3	1	1	3
CO2	3			2		2	3	3	1	1	3
CO3	3			2		2	3	3	1	1	3
CO4	3			2		2	3	3	1	1	3
CO5	3			2		2	3	3	1	1	3
CO6	3			2		2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	2	3
CO3	3	2
CO4	2	3
CO5	3	2
CO6	3	3

Lecture wise Programme: **3 Hrs/Week**

List of Experiments

Expt. No	Title	CO
1.	Assessment of drug information queries	CO 2
2.	Discuss about Medication history interviews procedure	CO 1
3.	Discuss about Patients counseling techniques &communication skills	CO 3
4.	analyze the laboratory investigation parameters regarding with various diseases.	CO 4
5	Drug information query regarding with Rheumatoid Arthritis	CO 4
6	Assessment of Medication history interview of HIV/ AIDS Patient.	CO 5&6

Textbooks

1. A Textbook of Clinical Pharmacy Practice: Essential Concepts and Skill Edited by G. Parthasarathi, Karin Nyfort-Hansen, Milap C. Nagata Published by Orient Black swan
2. Practical Manual of Hospital and Clinical Pharmacy Author: K.S. Jain Published by Nirali Prakashan

References:

1. Clinical Pharmacy and Therapeutics, 6th Edition: Edited by Cate Whittlesea, BSc, MSc, PhD, Mephams and Karen Hodson, BSc (Pharm), MSc, PhD, MR Pharms, FFRPS

2. A Text Book of Clinical Pharmacy Practice: Essential Concepts and Skills. G. Parthasarathi, Karin Nyfort-Hansen, Milap C. Nagata

Websites

W1:https://jru.edu.in/studentcorner/labmanual/dpharm/2ndyear/Hospital%20&%20Clinical%2 0Pharmacy.pdf

W2:https://www.sciencedirect.com/science/article/pii/S095362052500187 6 **W3**:https://academic.oup.com/labmed/pages/case_studies

W4:https://www.mayoclinic.org/diseases-conditions/rheumatoid-arthritis/diagnosis- treatment/drc-20353653

BIOSTATISTICS AND RESEARCH METHODOLOGY –

THEORY COURSE CODE: 2516PY36

Course Objectives: Upon completion of the course, the student shall be able to

COB1: Equip students with the skills to design experiments and formulate research hypotheses for clinical and pharmaceutical studies.

COB2: Enable students to apply appropriate research methodologies and frameworks for conducting effective research studies.

COB3: Provide students with knowledge of various statistical methods to address and solve different research problems.

COB4: Develop students' proficiency in using statistical software packages such as SPSS, Epi Info, and SAS for data analysis and presentation.

COB5: Appraise the importance of computer systems in hospital and community pharmacies, focusing on patient data management, medication orders, and inventory control.

Course Outcomes: At the end of the course, the student will be able to:

CO 1 Design the experiment and research hypothesis for a project

CO 2 Explain the appropriate framework for research studies

CO 3 List the various statistical methods to solve different types of problems

CO 4 Demonstrate various statistical software packages

CO 5 Appraise the importance of Computer in hospital and Community Pharmacy **CO 6** Appraise the statistical technique in solving the pharmaceutical problems **Mapping of Course Outcomes with Program Outcomes:**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	2	1	2	3	3	1	1	3
CO2	3	1	1	2	1	2	3	3	1	1	3
CO3	3	1	1	2	1	2	3	3	1	1	3
CO4	3	1	1	2	1	2	3	3	1	1	3
CO5	3	1	1	2	1	2	3	3	1	1	3
CO6	3	1	1	2	1	2	3	3	1	1	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	3
CO3	3	2
CO4	2	3
CO5	2	2
CO6	2	2

Lecture wise Programme: **2 Hrs/Week**

Unit 1: Research Methodology

i. Types of clinical study designs:

a. Case studies

b. Observational studies

c. Interventional studies

ii. Designing the methodology

iii. Sample size determination and Power of a study:

iv. Determination of sample size for simple comparative experiments

v. Determination of sample size to obtain a confidence interval of specified width

vi. Power of a study

vii. Report writing and presentation of data

Unit 2: Biostatistics

i. Introduction

ii. Types of Data Distribution

iii. Measures Describing the Central Tendency Distributions- Average, Median, Mode

iv. Measurement of the Spread of Data- Range, Variation of Mean, Standard Deviation, Variance, Coefficient of Variation, Standard Error of Mean

v. Data Graphics

vi. Construction and Labeling of Graphs: Histogram, Pie charts, Scatter plots, Semilogarithmic plots

vii. Basics of Testing Hypothesis

viii. Null hypothesis, Level of significance, Power of test, P-value, Statistical estimation of confidence intervals.

ix. Level of significance (Parametric data): Students t-test (paired and unpaired), Chi Square test, Analysis of Variance (one-way and two-way)

x. Level of significance (non-parametric data): Sign test, Wilcoxan's signed rank test, Wilcoxan rank sum test, Mann Whitney U test, Kruskal-Wallis test (one-way ANOVA)

xi. Linear regression and correlation: Introduction, Pearson's and Spearman's correlation and correlation coefficient.

xii. Introduction to statistical software: SPSS, Epi Info, SAS.

xiii. Statistical Methods in Epidemiology

xiv. Incidence and prevalence, relative risk, attributable risk

Unit 3: Computer Applications in Pharmacy

i. Computer System in Hospital Pharmacy:

ii. Patterns of Computer use in Hospital Pharmacy

iii. Patient record database management

iv. Medication order entry

v. Drug labels and list

vi. Intravenous solution and admixture

vii. Patient medication profiles

viii. Inventory control

ix. Management report & Statistics.

x. Computer In Community Pharmacy

xi. Computerizing the Prescription Dispensing process

xii. Use of Computers for Pharmaceutical Care in community pharmacy

xiii. Accounting and General ledger system

xiv. Drug Information Retrieval & Storage

xv. Introduction – Advantages of Computerized Literature Retrieval

xvi. Use of Computerized Retrieval

Text books

1. Fundamentals of Biostatistics, Bernard Rosner, (edition as available), Cengage.
2. Biostatistics – A Foundation for Analysis in the Health Sciences, Wayne W. Daniel, Chad L. Cross, (edition as available), Wiley.
3. Designing Clinical Research, Stephen B. Hulley, Steven R. Cummings, Warren S. Browner, Deborah G. Grady, Thomas B. Newman, (edition as available), Lippincott Williams & Wilkins.

Reference books:

1. Pharmaceutical statistics- practical and clinical applications, Sanford Bolton 3rd edition, publisher Marcel Dekker Inc. NewYork.
2. Drug Information- A Guide for Pharmacists, Patrick M Malone, Karen L Kier, John EStanovich , 3rd edition, McGraw Hill Publications 2006

Web links

W1; https://www.cdc.gov/epiinfo/

W2

https://www.ibm.com/products/spss-

statistics **W3**

https://www.sas.com/en_us/software/stat.

html **W4** https://www.strobe-

statement.org/

BIOPHARMACEUTICS AND PHARMACOKINETICS (THEORY)

Subject code: 2516PY37

Course Objectives (COBs): Upon completion of this course, the student shall be able to:

COB1: Understand the principles of drug absorption, distribution, metabolism, and elimination processes.
COB2: Grasp the fundamentals of pharmacokinetics and its importance in drug design and therapy.
COB3: Explain various compartmental and non-compartmental pharmacokinetic models used for drug disposition analysis.
COB4: Analyze multiple-dose regimens and predict drug levels in the body under different dosing conditions.
COB5: Understand the concepts of bioavailability and bioequivalence, their study designs, and assessment methods.

Course Outcomes (COs): At the end of the course, the student will be able to:

CO1: Describe drug absorption, distribution, metabolism, and elimination processes in bio- pharmaceutics.
CO2: Explain the mathematical and compartmental models used in pharmacokinetics.
CO3: Apply the one-compartment and multi-compartment models to evaluate drug concentration profiles.
CO4: Analyze multiple dosage regimens to predict therapeutic drug levels and avoid toxicity.
CO5: Discuss the factors responsible for non-linear pharmacokinetics and estimate parameters using appropriate models.
CO6: Evaluate bioavailability and bioequivalence parameters and design relevant studies.

Mapping of Course Outcomes with Program Outcomes (CO-PO Matrix):

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	3	3	2	2	1	1	2	2	2
CO 2	3	3	3	3	2	2	1	1	2	2	2
CO 3	3	3	3	3	2	2	1	1	2	2	2
CO 4	3	3	3	3	2	2	1	1	2	2	2
CO 5	3	3	3	3	2	2	1	1	2	2	2
CO 6	3	3	3	3	2	2	1	1	2	2	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	3
CO3	3	3
CO4	3	3
CO5	3	3.
CO6	3	3

Lecture wise Programme: **3 Hrs/Week**

1. Biopharmaceutics

1. Introduction to Biopharmaceutics

a. Absorption of drugs from gastrointestinal tract.

b. Drug Distribution.

c. Drug Elimination.

2. Pharmacokinetics

2. Introduction to Pharmacokinetics.

a. Mathematical model

b. Drug levels in blood.

c. Pharmacokinetic model

d. Compartment models

e. Pharmacokinetic study.

3. One compartment open model.

a. Intravenous Injection (Bolus)

b. Intravenous infusion.

4. Multicompartment models.

a. Two compartment open model.

b. IV bolus, IV infusion and oral administration

5. Multiple – Dosage Regimens.

a. Repititive Intravenous injections – One Compartment Open Model

b. Repititive Extravascular dosing – One Compartment Open model

c. Multiple Dose Regimen – Two Compartment Open Model

6. Nonlinear Pharmacokinetics.

a. Introduction

b. Factors causing Non-linearity.

c. Michaelis-menton method of estimating parameters.

7. Noncompartmental Pharmacokinetics.

a. Statistical Moment Theory.

b. MRT for various compartment models.

c. Physiological Pharmacokinetic model.

8. Bioavailability and Bioequivalence.

a. Introduction.

b. Bioavailability study protocol.

c. Methods of Assessment of Bioavailability

Text Books

1. Biopharmaceutics and Pharmacokinetics – A Treatise, Author: D.M. Brahmankar & Sunil B. Jaiswal, Publisher: Vallabh Prakashan.

2. Applied Biopharmaceutics and Pharmacokinetics, Author: Leon Shargel, Andrew B.C. Yu, Publisher: McGraw-Hill Education.

Reference Books:

1. Pharmacokinetics, Author: Milo Gibaldi, Publisher: Marcel Dekker Inc.
2. Clinical Pharmacokinetics: Concepts and Applications, Authors: Malcolm Rowland, Thomas N. Tozer, Publisher: Lea & Febiger.
3. Remington: The Science and Practice of Pharmacy, Publisher: Lippincott Williams & Wilkins.

Web References:

W1. https://www.pharmacokinetics.ca

W2. https://www.pharmacokineticssolutions.com/michaelis-menten-kinetics/

W3. https://www.fda.gov/drugs/bioequivalence-and-bioavailability

W4. https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical- science/pharmacokinetic-model

W5. https://www.pharmaguideline.com/2018/05/pharmacokinetics-adme-process.html

Biopharmaceutics and Pharmacokinetics (Practical)

Subject code: 2516PY42

Course Objectives (COBs): Upon completion of this course, the student shall be able to: **COB1:** Demonstrate the improvement of drug dissolution and solubility characteristics. **COB2:** Analyze plasma-protein binding and its influence on pharmacokinetics.

COB3: Evaluate bioavailability and bioequivalence of drugs using in vitro and in vivo models.

COB4: Determine various pharmacokinetic parameters like Ka, Ke, t1/2, Cmax, AUC, MRT, etc.

COB5: Perform drug absorption, elimination, metabolism, and renal clearance studies using appropriate laboratory techniques.

Course Outcomes (COs): At the end of the course, the student will be able to:

CO1: Improve and assess dissolution characteristics of slightly soluble drugs.

CO2: Evaluate the impact of polymorphism and protein binding on drug solubility and pharmacokinetics.

CO3: Calculate pharmacokinetic parameters (Ka, Ke, t1/2, AUC, Cmax, MRT) from blood and urinary excretion data.

CO4: Design and conduct bioavailability and bioequivalence studies using animal or human models.

CO5: Analyze in vitro absorption and metabolism pathways of various drugs.

CO6: Determine renal clearance and study the kinetics of drug elimination in biological samples.

Mapping of Course Outcomes with Program Outcomes (CO-PO Matrix):

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	3	3	2	2	1	1	2	2	2
CO 2	3	3	3	3	2	2	1	1	2	2	2
CO 3	3	3	3	3	2	2	1	1	2	2	2
CO 4	3	3	3	3	2	2	1	1	2	2	2
CO 5	3	3	3	3	2	2	1	1	2	2	2
CO 6	3	3	3	3	2	2	1	1	2	2	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	3
CO2	3	3
CO3	3	3
CO4	3	3
CO5	3	3
CO6	3	3

Lecture wise Programme: **3 Hrs/Week**

List of Experiments:

Expt. No	Title	CO
1.	Improvement of dissolution characteristics of slightly soluble drugs by some methods	**CO1**
2.	Comparison of dissolution studies of two different marketed products of same drug.	**CO1**
3.	Influence of polymorphism on solubility and dissolution	**CO1**
4.	Protein binding studies of highly protein bound drugs and poorly protein bound drugs	**CO2**
5.	Extent of plasma protein binding studies on the same drug (highly and poorly protein bound) at different concentrations	**CO2**
6.	Bio availability studies of some commonly used drugs on animals/human models	**CO2**
7.	Calculation of AUC, AUMC, MRT, Cmax from blood profile data	**CO3**
8.	Calculation of bio availability from urinary excretion data for two drugs	**CO3**
9.	Calculation of AUC and bio equivalence from the given data for two drugs	**CO3**
10.	*In vitro* absorption studies	**CO3**
11.	bio equivalence studies on the different drugs marketed tetracycline, sulphamethoxazole, trimethoprome, aspirin on animals and human models	**CO4**
12.	Absorption studies in animal inverted intestine using various drugs	**CO4**
13.	Effect on contact time on the plasma protein binding of the drugs	**CO5**
14.	Studying metabolic pathways for different drugs based on elimination	**CO5**
15.	Calculation of elimination half life for different drugs by using urinary elimination data and blood level data.	**CO6**
16.	Determination of renal clearance	**CO6**

Text Books:

1. Biopharmaceutics and Pharmacokinetics: A Treatise, Authors: D.M. Brahmankar, Sunil B. Jaiswal, Publisher: Vallabh Prakashan
2. Applied Biopharmaceutics and Pharmacokinetics, Authors: Leon Shargel, Andrew B.C. Yu, Publisher: McGraw-Hill Education

Reference Books:

1. Pharmacokinetics, Author: Milo Gibaldi, Publisher: Marcel Dekker Inc.
2. Remington: The Science and Practice of Pharmacy, Publisher: Lippincott Williams & Wilkins
3. Clinical Pharmacokinetics: Concepts and Applications, Authors: Malcolm Rowland, Thomas N. Tozer, Publisher: Lea & Febiger

Web Links:

W1.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6139426

/ W2. https://www.fda.gov/drugs/bioavailability-and-

bioequivalence

W3. https://www.pharmaguideline.com/2019/01/dissolution-

testing.html W4. https://www.pharmacokinetics.ca/sample-

calculations.html

W5. https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical- science/renal-clearance

CLINICAL TOXICOLOGY- THEORY

Course Code: 2516PY38

Course Objectives: Upon completion of the course, the student shall be able to

COB1: Understand and apply general principles in the diagnosis and management of various types of poisoning, including acute and chronic toxic exposures.

COB2: Demonstrate knowledge of antidotes, their mechanisms, clinical applications, and the supportive care required in toxicological emergencies.

COB3: Analyze toxicokinetic principles and various methods such as gut decontamination and elimination enhancement to manage poisoning cases effectively.

COB4: Identify and interpret the clinical symptoms and treatment protocols for poisoning due to pesticides, drugs, alcohol, heavy metals, and radiation.

COB5: Evaluate and manage envenomation cases including snake bites, arthropod stings, and plant poisonings, with emphasis on first aid and clinical interventions.

COB6: Recognize signs and symptoms of substance abuse and addiction, and develop therapeutic strategies for treating dependence on CNS stimulants, depressants, opioids, and hallucinogens.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Explain the general principles involved in the management of poisoning, Antidotes and supportive care.
CO2: Explain the Gut Decontamination, Elimination Enhancement techniques & Toxicokinetics.
CO3: Describe about clinical symptoms and management of acute and chronic poisoning **CO4:** Describe & understand various Families of venomous snakes and know symptoms, first aid & treatment
CO5: Describe about Plant, Food poisoning and Envenomations.
CO6: Illustrate on the signs and symptoms of substance abuse and treatment of dependence**.**

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3		3	2	2	2	2	1	2		2
CO2	3		3	2	2	2	2	1	2		2
CO3	3		3	2	2	2	2	1	2		2
CO4	3		2	2	2	2	2	1	3		2
CO5	3		2	2	2	2	2	1	3		2
CO6	3		2	2	2	2	2	1	3		2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	2
CO4	2	2
CO5	2	2
CO6	2	3

Lecture wise Programme: **2Hrs/Week**

1. General principles involved in the management of poisoning
2. Antidotes and the clinical applications.
3. Supportive care in clinical Toxicology.
4. Gut Decontamination.
5. Elimination Enhancement.
6. Toxicokinetic.
7. Clinical symptoms and management of acute poisoning with the following agents –

a) Pesticide poisoning: organophosphorus compounds, carbamates, organochlorines, pyrethroids.

b) Opiates overdose.

c) Antidepressants

d) Barbiturates and benzodiazepines.

e) Alcohol: ethanol, methanol.

f) Paracetamol and salicylates.

g) Non- steroidal anti - inflammatory drugs.

h) Hydrocarbons: Petroleum products and PEG.

i) Caustics: inorganic acids and alkali.

j) Radiation poisoning

8. Clinical symptoms and management of chronic poisoning with the following agents – Heavy metals: Arsenic, lead, mercury, iron, copper

9. Venomous snake bites: Families of venomous snakes, clinical effects of venoms, general management as first aid, early manifestations, complications and snake bite injuries.

10. Plants poisoning. Mushrooms, Mycotoxins.

11. Food poisonings

12. Envenomations – Arthropod bites and stings. Substance abuse:

Signs and symptoms of substance abuse and treatment of dependence

a) CNS stimulants: amphetamine

b) Opioids

c) CNS depressants

d) Hallucinogens: LSD

e) Cannabis group

f) Tobacco

Text Books:

1. Matthew J. Ellenhorn, *Ellenhorn's Medical Toxicology: Diagnosis and Treatment of Human Poisoning*, Second edition, Williams & Wilkins Publication, London.
2. V. V. Pillay, *Handbook of Forensic Medicine and Toxicology*, Thirteenth edition, 2003, Paras Publication, Hyderabad.

Reference Books:

1. Curtis D. Klaassen, *Casarett & Doull's Toxicology: The Basic Science of Poisons*, Ninth edition, McGraw-Hill Education.
2. Lewis R. Goldfrank, Neal Flomenbaum et al., *Goldfrank's Toxicologic Emergencies*, Eleventh edition, McGraw-Hill Education.
3. Frank A. Barile, *Clinical Toxicology: Principles and Mechanisms*, Third edition, CRC Press.

Web Links:

W1: https://onlinecourses.swayam2.ac.in/ini25_bt08/preview
W2: https://www.ncbi.nlm.nih.gov/books/?term=forensic+toxicology
W3: https://www.merckmanuals.com/professional/injuries-poisoning/poisoning
W4: https://open.umn.edu/opentextbooks/textbooks?q=clinical+toxicology&commit=Go
W5:https://www.medscape.com/viewarticle/996108?_gl=1*1vt62ew*_gcl_au*MzMzMjI3NTE3 LjE3NTEz NTQwNjY.

5th YEAR

CLINICAL RESEARCH-THEORY

Course Code: 2516PY43

Course Objectives: On completion of this course, the student will able to

COB1: To understand the regulatory and ethical requirements.

COB2: To know the concept of the new drug development process.

COB3: To conduct the clinical trials per regulatory and ethical requirements.

COB4: To know safety monitoring and reporting in clinical trials.

COB5: To coordinate the clinical trials and promote quality drug trial research.

COURSE OUTCOMES: : At the end of the course, the student will be able to

CO1: Discuss the Pharmacological and Toxicological considerations in the process of development of new drugs

CO2: Discuss the principles and phases in the clinical trial of the drug

CO3: Explain the guidelines for ethics and safe monitoring in the clinical trial of a drug.

CO4: Design the documents of clinical trials.

CO5: Distinguish the guidelines of national and international regulatory bodies for clinical trials.

CO6: Recognize differing roles and obligations of the Investigator, Sponsor, and Institutional Review Board.

Mapping of Course Outcomes with Program Outcomes:

CO/P O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1
CO1	3			3		2	3	3	3	2	3
CO2	3			3		2	3	3	3	2	3
CO3	3			3		2	3	3	3	2	3
CO4	3			3		2	3	3	3	2	3
CO5	3			2		2	3	3	3	2	3
CO6	3			2		2	3	3	3	2	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	3
CO3	2	3
CO4	3	2
CO5	3	2
CO6	2	3

Lecture wise programme: **3 Hrs. Week**

1. Drug development process:

Introduction

Various Approaches to drug discovery

1. Pharmacological
2. Toxicological
3. IND Application
4. Drug characterization
5. Dosage form

2. Clinical development of drug:

1. Introduction to Clinical trials
2. Various phases of clinical trial.
3. Methods of post marketing surveillance
4. Abbreviated New Drug Application submission.
5. Good Clinical Practice – ICH, GCP, Central drug standard control organization (CDSCO) guidelines
6. Challenges in the implementation of guidelines
7. Ethical guidelines in Clinical Research
8. Composition, responsibilities, procedures of IRB / IEC
9. Overview of regulatory environment in USA, Europe and India.
10. Role and responsibilities of clinical trial personnel as per ICH GCP

a. Sponsor

b. Investigators

c. Clinical research associate

d. Auditors

e. Contract research coordinators

f. Regulatory authority

11. Designing of clinical study documents (protocol, CRF, ICF, PIC with assignment)

12. Informed consent Process

13. Data management and its components

14. Safety monitoring in clinical trials.

Text Books:

1. Principles and practice of pharmaceutical medicine, Second edition. Authors: Lionel. D. Edward, Andrew. J. Fletcher Anthony W FOS, Peter D Sloaier Publisher: Wiley;

2. Handbook of clinical research. Julia Lloyd and Ann Raven Ed. Churchill Livingstone

Reference books:

1. Central Drugs Standard Control Organization. Good Clinical Practices-Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.

2. International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996.

3. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi

Web links:

W1: https://www.aitbspublishersindia.com/Textbook-of-Clinical-Research

W2: https://www.clinicalresearchresources.com/products/book-cg1-2024-comprehensive- clinical-research-desk-reference-for-drug-and-medical-device-trials-with-new-fda- informed-consent-guidance

W3: https://tilda.tcd.ie/epidemiology-biostatistics-course/course-material/assets/Class2/Designingclinicalresearch_4th-edition.pdf

W4:https://glori.kg/wpcontent/uploads/2017/08/ClinicalResearchHandbook_EN.pdf

W5:https://www.researchgate.net/publication/301693574_Textbook_of_Clinical_Research- Vikas_Dhikav

PHARMACOEPIDEMIOLOGY & PHARMACOECONOMICS THEORY

Course code – 2516PY44

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

COB1: Analyses about different types of study designs in Pharmacoepidemiologic studies.

COB2: Understand about scope, history, evolution of Pharmacoepidemiology.

COB3: Compare the differences between Relative risk, Attribute risk.

COB4: Understand the concepts of Various studies like Meta analysis, Ad hoc data sources, Vaccine safety, & Pharmacoeconomic evaluation.

Course outcomes: At the Completion of the course the student shall be able to

CO 1: Compare different study designs

CO 2: Discuss about Origin and evolution of Pharmacoepidemiology

CO 3: Compare the difference between Prevalence & Incident rates

CO 4: Discuss the risk evaluation & Outcome measures in Pharmacoepidemiology

CO 5: Describe the process of Ad-hoc data studies and their management.

CO 6: Explain about different types of vaccines preparation.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9
CO 1	3		2	2		3		2	2
CO 2	3		2	2		3		2	2
CO3	3		2	2		3		2	2
CO4	3		2	2		3		2	2
CO5	3		2	2		3		2	2
CO6	3		2	2		3		2	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	3
CO3	2	3
CO4	2	2
CO5	2	2
CO6	1	2

Lecture wise Programme: **3 Hrs/Week**

UNIT – I.

Pharmacoepidemiology: Definition and scope: Origin and evaluation of pharmacoepidemiology need for pharmacoepidemiology, aims and applications. Measurement of outcomes in pharmacoepidemiology Outcome measure and drug use measures Prevalence, incidence and incidence rate. Monetary units, number of prescriptions, units of drugs dispensed, defined daily doses and prescribed daily doses, medication adherence measurement

UNIT – II

Concept of risk in pharmacoepidemiology Measurement of risk, attributable risk and relative risk, time-risk relationship and odds ratio

UNIT-III.

Pharmacoepidemiologic methods Includes theoretical aspects of various methods and practical study of various methods with the help of

case studies for individual methods Drug utilization review, case reports, case series, surveys of drug use, cross – sectional studies, cohort study.

UNIT-IV.

case –cohort studies, meta – analysis studies, spontaneous reporting, prescription event monitoring and record linkage system.

Sources of data for pharmacoepidemiologic studies Ad Hoc data sources and automated data systems.

UNIT –V.

Selected special applications of pharmacoepidemiology Studies of vaccine safety, hospital pharmacoepidemiology, pharmacoepidemiology and risk management, drug induced birth defects.

UNIT-VI.

. Phrmacoeconomics: Definition, history, needs of pharmacoeconomic evaluations Role in formulary management decisions.

UNIT-VII

Pharmacoeconomic evaluation Outcome assessment and types of evaluation Includes theoretical aspects of various methods and practical study of various methods with the help of case studies for individual methods: Cost – minimization, cost- benefit, cost – effectiveness, cost utility

UNIT-VIII.

Applications of Pharmacoeconomics Software and case studies

Textbooks:

1. International Concepts and Methods of Pharmacoepidemiology (Hb 2023) By McKeage M.
2. Drug safety and Pharmacoepidemiology by Avianna Stokes.
3. Essentials of Pharmacoeconomics: Health Economics and Outcomes Research, Third Edition by Karen Rascati.

Reference books

1. Text book of pharmacoepidemiology and pharmacies\nomics Brain L STORM; 6th edition. Wiley publications.
2. Understanding Pharmacoepidemiology by Whelchel Medicare Health Science Publishers.

Web links:

W1:
https://books.google.com/books/about/Textbook_of_Pharmacoepidemiology.html?id=Pa MRA AAAQBA

W2: https://www.slideshare.net/slideshow/concept-of-risk-in-pharmacoepidemiology- presentation/250685906.

W3: https://www.slideshare.net/slideshow/measurement-of-outcomes-in- pharacoepidemiology/227587818.

W4: https://pharmdguru.com/pharmacoepidemiology-definition-and-scope/.

W5:
https://pharmareview.wordpress.com/wpcontent/uploads/2011/10/pharmacoepidemiolo g y.pdf

CLINICAL PHARMACOKINETICS AND PHARMACOTHERAPEUTIC DRUG MONITORING (THEORY)

Course code: 2516PY45

Course Objectives: Upon completion of the subject student shall be able to –

COB 1: understand the basics of drug dosing

COB2: Understand about dose adjustment in renal and hepatic disease

COB3; Understand about population pharmacokinetics.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Gain knowledge about dose and dosing intervals

CO2. Understand about drug

interactions **CO3:** Individualize

drug dosage regimen **CO4:** Dose

adjustment in renal impairment

CO5: Adaptive feedback

mechanism

CO6: Genetic polymorphism in drug targets.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3			3		2	3	3	3	2	3
CO2	3			3		2	3	2	3	2	3
CO3	3			3		2	3	3	3	3	3
CO4	3			3		2	3	3	3	2	3
CO5	3			2		2	2	3	3	2	3
CO6	3			2		2	3	3	3	2	3

Mapping of Course Outcomes with Program Specific Outcomes;

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	3
CO3	2	3
CO4	3	2
CO5	3	2
CO6	3	2

Lecture wise Programme: **2 Hrs/Week**

1. **Introduction to Clinical pharmacokinetics**

2. Design of dosage regimens:

Nomograms and Tabulations in designing dosage regimen, Conversion from intravenous to oral dosing, Determination of dose and dosing intervals, Drug dosing in the elderly and pediatrics and obese patients.

3. Pharmacokinetics of Drug Interaction:

a. Pharmacokinetic drug interactions b. Inhibition and Induction of Drug metabolism c. Inhibition of Biliary Excretion

. **4. Therapeutic Drug monitoring:**

a. Introduction b. Individualization of drug dosage regimen (Variability – Genetic, Age and Weight, disease, Interacting drugs). c. Indications for TDM. Protocol for TDM. d. Pharmacokinetic/Pharmacodynamic Correlation in drug therapy. e. TDM of drugs used in the following disease conditions: cardiovascular disease, Seizure disorders, Psychiatric conditions, and Organ transplantations

5. Dosage adjustment in Renal and hepatic Disease.

a. Renal impairment b. Pharmacokinetic considerations c. General approach for dosage adjustment in renal disease. d. Measurement of Glomerular Filtration rate and creatinine clearance. e. Dosage adjustment for uremic patients. f. Extracorporeal removal of drugs. g. Effect of Hepatic disease on pharmacokinetics.

6. Population Pharmacokinetics.

a. Introduction to Bayesian Theory. b. Adaptive method or Dosing with feedback. c. Analysis of Population pharmacokinetic Data.

7. Pharmacogenetics

a. Genetic polymorphism in Drug metabolism: Cytochrome P-450 Isoenzymes. b. Genetic Polymorphism in Drug Transport and Drug Targets. c. Pharmacogenetics and Pharmacokinetics/Pharmacodynamic considerations

Text Books:

1. Winter's Basic Clinical Pharmacokinetics - Michael E. Winter

2. Clinical Pharmacokinetics & Pharmacodynamics: Concepts and Applications - Malcolm Rowland & Thomas Tozer

Reference books:

1. Clinical Pharmacokinetics (7th Edition) - John E. Murphy

2. Applied Biopharmaceutics & Pharmacokinetics - Leon Shargel, Susanna Wu-Pong & Andrew B. C. Yu.

Web Links:

W 1 https://accp1.onlinelibrary.wiley.com/doi/abs/10.1002/j.1552-4604.1992.tb03828.x

W 2 https://renaissance.stonybrookmedicine.edu/anesthesiology/teaching/peds-drug-dosages

W 3 https://w3c.github.io/tdm-reservation-protocol/docs/tdm-meaning.html

W 4 https://www.annualreviews.org/content/journals/10.1146/annurev.pa.27.040187.001125

W 5 https://plato.stanford.edu/entries/bayes-theorem/