B. Pharmacy Four Year Degree Program

PROGRAM CURRICULUM

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

For

BACHELOR OF PHARMACY

ADITYA
UNIVERSITY

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

B. Pharmacy Program Curriculum – 2025

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

Category-wise Credit Division

S. No.	Broad Category of Courses	Credits
1	Major Core Courses (MCC)	164
2	University Elective Courses (UEC)	8
3	Ability Enhancement Courses (AEC)	6[$]/7[#]
4	Skill Enhancement Courses (SEC)	19
5	Value Added Courses (VAC)	4
6	Summer Internships (SI)	6
7	Full Semester Internship (PROJ)	6
Total Credits to be earned for B. Pharmacy Degree		**213[$]/214[#]**

[$] Applicable ONLY for the students who studied Physics / Chemistry/ Botany/ Zoology at Higher Secondary Education/Intermediate and appearing for Remedial Mathematics course.
[#] Applicable ONLY for the students who studied Mathematics / Physics / Chemistry at Higher Secondary Education/Intermediate and appearing for Remedial Biology course.

Foundation Courses – FC

Intermediate-level Courses - IC

Advanced Courses – AC

Major Core Courses (MCC)

Course Code	Sem	Course Name	Level	L	T	P	C	CIE	SEE	Total
2513PY01	I	Human Anatomy and Physiology I– Theory	FC	3	1		4	25	75	100
2513PY02		Pharmaceutical Analysis I – Theory	FC	3	1		4	25	75	100
2513PY03		Pharmaceutics I – Theory	FC	3	1		4	25	75	100
2513PY04		Pharmaceutical Inorganic Chemistry– Theory	FC	3	1		4	25	75	100
2513PY08		Human Anatomy and Physiology– Practical	FC			2	2	15	35	50
2513PY09		Pharmaceutical Analysis I – Practical	FC			2	2	15	35	50
2513PY10		Pharmaceutics I – Practical	FC			2	2	15	35	50
2513PY11		Pharmaceutical Inorganic Chemistry– Practical	FC			2	2	15	35	50
2513PY14	II	Human Anatomy and Physiology II – Theory	IC	3	1		4	25	75	100
2513PY15		Pharmaceutical Organic Chemistry I – Theory	FC	3	1		4	25	75	100
2513PY16		Biochemistry– Theory	FC	3	1		4	25	75	100
2513PY17		Pathophysiology – Theory	IC	3	1		4	25	75	100
2513PY20		Human Anatomy and Physiology II –Practical	IC			2	2	15	35	50
2513PY21		Pharmaceutical Organic Chemistry I– Practical	FC			2	2	15	35	50
2513PY22		Biochemistry– Practical	FC			2	2	15	35	50
2513PY24	III	Pharmaceutical Organic Chemistry II – Theory	IC	3	1		4	25	75	100

2513PY25	III	Physical Pharmaceutics I – Theory	FC	3	1		4	25	75	100
2513PY26		Pharmaceutical Microbiology– Theory	FC	3	1		4	25	75	100
2513PY27		Pharmaceutical Engineering – Theory	IC	3	1		4	25	75	100
2513PY28		Pharmaceutical Organic Chemistry II – Practical	IC			2	2	15	35	50
2513PY29		Physical Pharmaceutics I – Practical	FC			2	2	15	35	50
2513PY30		Pharmaceutical Microbiology– Practical	FC			2	2	15	35	50
2513PY31		Pharmaceutical Engineering –Practical	IC			2	2	15	35	50
2513PY32	IV	Pharmaceutical Organic Chemistry III– Theory	IC	3	1		4	25	75	100
2513PY33		Medicinal Chemistry I – Theory	IC	3	1		4	25	75	100
2513PY34		Physical Pharmaceutics II – Theory	IC	3	1		4	25	75	100
2513PY35		Pharmacology I – Theory	FC	3	1		4	25	75	100
2513PY36		Pharmacognosy and Phytochemistry I– Theory	FC	3	1		4	25	75	100
2513PY37		Medicinal Chemistry I – Practical	IC			2	2	15	35	50
2513PY38	IV	Physical Pharmaceutics II – Practical	IC			2	2	15	35	50
2513PY39		Pharmacology I – Practical	FC			2	2	15	35	50
2513PY40		Pharmacognosy and Phytochemistry I – Practical	FC			2	2	15	35	50

2513PY41	V	Medicinal Chemistry II – Theory	IC	3	1		4	25	75	100
2513PY42		Industrial Pharmacy I– Theory	IC	3	1		4	25	75	100
2513PY43		Pharmacology II – Theory	IC	3	1		4	25	75	100
2513PY44		Pharmacognosy and Phytochemistry II– Theory	IC	3	1		4	25	75	100
2513PY46		Industrial Pharmacy I – Practical	IC			2	2	15	35	50
2513PY47		Pharmacology II – Practical	IC			2	2	15	35	50
2513PY48		Pharmacognosy and Phytochemistry II – Practical	IC			2	2	15	35	50
2513PY50	VI	Medicinal Chemistry III – Theory	AC	3	1		4	25	75	100
2513PY51		Pharmacology III – Theory	AC	3	1		4	25	75	100
2513PY52		Herbal Drug Technology– Theory	AC	3	1		4	25	75	100
2513PY53		Biopharmaceutics and Pharmacokinetics – Theory	AC	3	1		4	25	75	100
2513PY54		Pharmaceutical Biotechnology– Theory	AC	3	1		4	25	75	100
2513PY55		Quality Assurance – Theory	IC	3	1		4	25	75	100
2513PY56		Medicinal chemistry III – Practical	AC			2	2	15	35	50
2513PY57		Pharmacology III – Practical	AC			2	2	15	35	50

2513PY59	VII	Instrumental Methods of Analysis – Theory	AC	3	1		4	25	75	100
2513PY60		Industrial Pharmacy II - Theory	AC	3	1		4	25	75	100
2513PY61		Pharmacy Practice – Theory	IC	3	1		4	25	75	100
2513PY62		Novel Drug Delivery System – Theory	AC	3	1		4	25	75	100
Total				**106**	**32**	**40**	**178**			

Ability Enhancement Courses (AEC)

Course Code	Sem	Course Name	Level	L	T	P	C	CIE	SEE	Total
2513PY05	I	Communication skills – Theory*	FC	2			2	15	35	50
2513PY06 2513PY07	I	Remedial Biology (or) Remedial Mathematics	FC	2			2	15	35	50
2513PY12	I	Communication skills – Practical*	FC			1	1	10	15	25
2513PY13	I	Remedial Biology– Practical*	FC			1	1	10	15	25
2513PY79	VIII	Student Activity Based Learning	AC				1			
Total				**4**		**2**	**7**			

Skill Enhancement Courses (SEC)

Course Code	Sem	Course Name	Level	L	T	P	C	CIE	SEE	Total
2513PY23	II	Computer Applications in Pharmacy– Practical*	FC			1	1	10	15	25
2513PY18		Computer Applications in Pharmacy – Theory*	FC	3			3	25	50	75
2513PY19		Environmental sciences – Theory*	FC	3			3	25	50	75
2513PY58	VI	Herbal Drug Technology– Practical	AC			2	2	15	35	50
2513PY63	VII	Instrumental Methods of Analysis – Practical	AC			2	2	15	35	50
2513PY65	VII	Biostatistics and Research Methodology	AC	3	1		4	25	75	100
2513PY66		Social and Preventive Pharmacy	AC	3	1		4	25	75	100
Total				12	2	**5**	**19**			

Value Added Courses (VAC)

Course Code	Sem	Course Name	Level	L	T	P	C	CIE	SEE	Total
2513PY45	V	Pharmaceutical Jurisprudence – Theory	FC	3	1		4	25	75	100
Total				**3**	**1**		**4**			

Summer Internship (SI)

Course Code	Sem	Course Name	Level	L	T	P	C	CIE	SEE	Total
2513PY49	VIII	Industrial Training	IC			150				
2513PY64	VII	Summer Internship (Practice School)	IC	6			6	25	125	150
			Total	**6**		**150**	**6**	**25**	125	150

Full Semester Internship (PROJ)

Course Code	Sem	Course Name	Level	L	T	P	C	CIE	SEE	Total
2513PY78	VIII	Project Work	AC	6			6	50	100	150
Total				**6**			**6**			

University Elective Courses (UEC)

Course Code	Sem	Course Name	Level	L	T	P	C	CIE	SEE	Total
2513PY67	VIII	Pharma Marketing Management	AC	3	1		4	25	75	100
2513PY68		Pharmaceutical Regulatory Science	AC	3	1		4	25	75	100
2513PY69		Pharmacovigilance	AC	3	1		4	25	75	100
2513PY70		Quality Control and standardization of Herbals	AC	3	1		4	25	75	100
2513PY71		Computer Aided Drug Design	AC	3	1		4	25	75	100
2513PY72		Cell and Molecular Biology	AC	3	1		4	25	75	100
2513PY73		Cosmetic Science	AC	3	1		4	25	75	100
2513PY74		Experimental Pharmacology / Pharmacological Screening methods	AC	3	1		4	25	75	100
2513PY75		Advanced Instrumentation Techniques	AC	3	1		4	25	75	100
2513PY76		Dietary Supplements and Nutraceuticals	AC	3	1		4	25	75	100
2513PY77		Pharmaceutical Product Development	AC	3	1		4	25	75	100
Total				**6**	**2**		**8**			

Note: Students can register for any two courses across University Elective Courses (UEC) of Semester VIII as per the curriculum.

LEVEL-WISE COURSES

FOUNDATION COURSES		INTERMEDIATE COURSES		ADVANCED COURSES	
HAP-I (T)	Human Anatomy and Physiology I– Theory	HAP-II (T)	Human Anatomy and Physiology II – Theory	MC-III (T)	Medicinal Chemistry III – Theory
PA-I (T)	Pharmaceutical Analysis I – Theory	PP (T)	Pathophysiology – Theory	PCOL-III (T)	Pharmacology III – Theory
PHC-I (T)	Pharmaceutics I – Theory	HAP-II (P)	Human Anatomy and Physiology II –Practical	HDT (T)	Herbal Drug Technology– Theory
PIC (T)	Pharmaceutical Inorganic Chemistry– Theory	POC-II (T)	Pharmaceutical Organic Chemistry II – Theory	BPPK (T)	Biopharmaceutics and Pharmacokinetics – Theory
CS (T)	Communication skills – Theory*	PE (T)	Pharmaceutical Engineering – Theory	PBT (T)	Pharmaceutical Biotechnology– Theory
RB / RM (T)	Remedial Biology/Remedial Mathematics– Theory*	POC-II (P)	Pharmaceutical Organic Chemistry II – Practical	MC-III (P)	Medicinal chemistry III – Practical
HAP-I (P)	Human Anatomy and Physiology–I Practical	PE (P)	Pharmaceutical Engineering – Practical	PCOL-III (P)	Pharmacology III – Practical
PA-I (P)	Pharmaceutical Analysis I – Practical	POC-III (T)	Pharmaceutical Organic Chemistry III– Theory	HDT (P)	Herbal Drug Technology– Practical
PHC-I (P)	Pharmaceutics I – Practical	MC-I (T)	Medicinal Chemistry I – Theory	IMA (T)	Instrumental Methods of Analysis – Theory
PIC (P)	Pharmaceutical Inorganic Chemistry– Practical	PP-II (T)	Physical Pharmaceutics II – Theory	IP-II (T)	Industrial Pharmacy II – Theory
CS (P)	Communication skills – Practical*	MC-I (P)	Medicinal Chemistry I – Practical	NDDS (T)	Novel Drug Delivery System – Theory
RB (P)	Remedial Biology– Practical*	PP-II (P)	Physical Pharmaceutics II – Practical	IMA (P)	Instrumental Methods of Analysis – Practical
POC-I (T)	Pharmaceutical Organic Chemistry I – Theory	MC-II (T)	Medicinal Chemistry II – Theory	BRM (T)	Biostatistics and Research Methodology
BC (T)	Biochemistry– Theory	IP-I (T)	Industrial Pharmacy I– Theory	SPP (T)	Social and Preventive Pharmacy

FOUNDATION COURSES		INTERMEDIATE COURSES		ADVANCED COURSES	
CAP (T)	Computer Applications in Pharmacy – Theory*	PCOL-II (T)	Pharmacology II – Theory	PMKT (T)	Pharma Marketing Management
ES (T)	Environmental sciences – Theory*	PCG-II (T)	Pharmacognosy and Phytochemistry II– Theory	PRS (T)	Pharmaceutical Regulatory Science
POC-I (P)	Pharmaceutical Organic Chemistry I– Practical	IP-I (P)	Industrial Pharmacy I – Practical	PVG (T)	Pharmacovigilance
BC (P)	Biochemistry– Practical	PCOL-II (P)	Pharmacology II – Practical	QCSH (T)	Quality Control and Standardization of Herbals
CAP (P)	Computer Applications in Pharmacy– Practical*	PCG-II (P)	Pharmacognosy and Phytochemistry II – Practical	CADD (T)	Computer Aided Drug Design
PP-I (T)	Physical Pharmaceutics I – Theory	QA (T)	Quality Assurance –Theory	CMB (T)	Cell and Molecular Biology
PM (T)	Pharmaceutical Microbiology– Theory	PPRA (T)	Pharmacy Practice – Theory	COS (T)	Cosmetic Science
PP-I (P)	Physical Pharmaceutics I – Practical	PS	Practice School*	EXP (T)	Experimental Pharmacology / Pharmacological Screening methods
PM (P)	Pharmaceutical Microbiology– Practical			AIT (T)	Advanced Instrumentation Techniques
PCOL-I (T)	Pharmacology I – Theory			DSN (T)	Dietary Supplements and Nutraceuticals
PCG-I (T)	Pharmacognosy and Phytochemistry I– Theory			PPD	Pharmaceutical Product Development
PCOL-I (P)	Pharmacology I – Practical			PW	Project Work
PCG-I (P)	Pharmacognosy and Phytochemistry I – Practical				
PJ (T)	Pharmaceutical Jurisprudence – Theory				

SEMESTER-WISE CURRICULUM

I SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2513PY01	Human Anatomy and Physiology I– Theory	MCC	FC	3	1		4	4
2513PY02	Pharmaceutical Analysis I –Theory	MCC	FC	3	1		4	4
2513PY03	Pharmaceutics I–Theory	MCC	FC	3	1		4	4
2513PY04	Pharmaceutical Inorganic Chemistry– Theory	MCC	FC	3	1		4	4
2513PY05	Communication skills–Theory*	AEC	FC	2			2	2
2513PY06 & 2513PY13	Remedial Biology Theory & Remedial Biology Practical*# (Or)	AEC	FC	2		1	3#	2
2513PY07	Remedial Mathematics– Theory*$			2			2$	2
2513PY08	Human Anatomy and Physiology– Practical	MCC	FC			2	2	4
2513PY09	Pharmaceutical Analysis I–Practical	MCC	FC			2	2	4
2513PY10	Pharmaceutics I–Practical	MCC	FC			2	2	4
2513PY11	Pharmaceutical Inorganic Chemistry– Practical	MCC	FC			2	2	4
2513PY12	Communication skills–Practical*	AEC	FC			1	1	2
Total				**16**	**4**	**10**	**29$/30#**	**40**

***** The subject experts at department level shall conduct examinations

$ Applicable ONLY for the students studied who Physics / Chemistry/ Botany/ Zoology at Higher Secondary Education/Intermediate and appearing for Remedial Mathematics course**.**

Applicable ONLY for the students who studied Mathematics / Physics / Chemistry at Higher Secondary Education/Intermediate and appearing for Remedial Biology course**.**

II SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2513PY14	Human Anatomy and Physiology II–Theory	MCC	IC	3	1		4	4
2513PY15	Pharmaceutical Organic Chemistry I–Theory	MCC	FC	3	1		4	4
2513PY16	Biochemistry–Theory	MCC	FC	3	1		4	4
2513PY17	Pathophysiology –Theory	MCC	IC	3	1		4	4
2513PY18	Computer Applications in Pharmacy–Theory*	SEC	FC	3			3	3
2513PY19	Environmental sciences–Theory*	SEC	FC	3			3	3
2513PY20	Human Anatomy and Physiology II–Practical	MCC	IC			2	2	4
2513PY21	Pharmaceutical Organic Chemistry I–Practical	MCC	FC			2	2	4
2513PY22	Biochemistry –Practical	MCC	FC			2	2	4
2513PY23	Computer Applications in Pharmacy – Practical*	SEC	FC			1	1	2
Total				**18**	**4**	**7**	**29**	**36**

*The subject experts at department level shall conduct examinations

III SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2513PY24	Pharmaceutical Organic Chemistry II–Theory	MCC	IC	3	1		4	4
2513PY25	Physical Pharmaceutics I–Theory	MCC	FC	3	1		4	4
2513PY26	Pharmaceutical Microbiology–Theory	MCC	FC	3	1		4	4
2513PY27	Pharmaceutical Engineering–Theory	MCC	IC	3	1		4	4
2513PY28	Pharmaceutical Organic Chemistry II–Practical	MCC	IC			2	2	4
2513PY29	Physical Pharmaceutics I–Practical	MCC	FC			2	2	4
2513PY30	Pharmaceutical Microbiology–Practical	MCC	FC			2	2	4
2513PY31	Pharmaceutical Engineering–Practical	MCC	IC			2	2	4
Total				**12**	**4**	**8**	**24**	**32**

IV SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2513PY32	Pharmaceutical Organic Chemistry III–Theory	MCC	IC	3	1		4	4
2513PY33	Medicinal Chemistry I–Theory	MCC	IC	3	1		4	4
2513PY34	Physical Pharmaceutics II–Theory	MCC	IC	3	1		4	4
2513PY35	Pharmacology I–Theory	MCC	FC	3	1		4	4
2513PY36	Pharmacognosy and Phytochemistry I–Theory	MCC	FC	3	1		4	4
2513PY37	Medicinal Chemistry I–Practical	MCC	IC			2	2	4
2513PY38	Physical Pharmaceutics II–Practical	MCC	IC			2	2	4
2513PY39	Pharmacology I–Practical	MCC	FC			2	2	4
2513PY40	Pharmacognosy and Phytochemistry I–Practical	MCC	FC			2	2	4
Total				**15**	**5**	**8**	**28**	**36**

V SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2513PY41	Medicinal Chemistry II–Theory	MCC	IC	3	1		4	4
2513PY42	Industrial Pharmacy I–Theory	MCC	IC	3	1		4	4
2513PY43	Pharmacology II–Theory	MCC	IC	3	1		4	4
2513PY44	Pharmacognosy and Phytochemistry II–Theory	MCC	IC	3	1		4	4
2513PY45	Pharmaceutical Jurisprudence–Theory	VAC	FC	3	1		4	4
2513PY46	Industrial Pharmacy I–Practical	MCC	IC			2	2	4
2513PY47	Pharmacology II–Practical	MCC	IC			2	2	4
2513PY48	Pharmacognosy and Phytochemistry II – Practical	MCC	IC			2	2	4
	Total			**15**	**5**	**6**	**26**	**32**

VI SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2513PY50	Medicinal Chemistry III–Theory	MCC	AC	3	1		4	4
2513PY51	Pharmacology III–Theory	MCC	AC	3	1		4	4
2513PY52	Herbal Drug Technology–Theory	MCC	AC	3	1		4	4
2513PY53	Biopharmaceutics and Pharmacokinetics–Theory	MCC	AC	3	1		4	4
2513PY54	Pharmaceutical Biotechnology–Theory	MCC	AC	3	1		4	4
2513PY55	Quality Assurance–Theory	MCC	IC	3	1		4	4
2513PY56	Medicinal chemistry III–Practical	MCC	AC			2	2	4
2513PY57	Pharmacology III–Practical	MCC	AC			2	2	4
2513PY58	Herbal Drug Technology –Practical	SEC	AC			2	2	4
	Total			**18**	**6**	**6**	**30**	**36**

VII SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2513PY59	Instrumental Methods of Analysis–Theory	MCC	AC	3	1		4	4
2513PY60	Industrial Pharmacy II–Theory	MCC	AC	3	1		4	4
2513PY61	Pharmacy Practice–Theory	MCC	IC	3	1		4	4
2513PY62	Novel Drug Delivery System–Theory	MCC	AC	3	1		4	4
2513PY63	Instrumental Methods of Analysis–Practical	SEC	AC			2	2	4
2513PY64	Summer Internship (Practice School)	SEC	IC	6			6	12
	Total			**18**	**4**	**2**	**24**	**32**

*Thesubject experts at department level shall conduct examinations

VIII SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2513PY65	Biostatistics and Research Methodology	SEC	AC	3	1		4	4
2513PY66	Social and Preventive Pharmacy	SEC	AC	3	1		4	4
2513PY67	Pharma Marketing Management (Or)	UEC	AC	3	1		4	4
2513PY68	Pharmaceutical Regulatory Science (Or)	UEC	AC	3	1		4	4
2513PY69	Pharmacovigilance (Or)	UEC	AC	3	1		4	4
2513PY70	Quality Control and Standardization of Herbals (Or)	UEC	AC	3	1		4	4
2513PY71	Computer Aided Drug Design (Or)	UEC	AC	3	1		4	4
2513PY72	Cell and Molecular Biology	UEC	AC	3	1		4	4
2513PY73	Cosmetic Science (Or)	UEC	AC	3	1		4	4
2513PY74	Experimental Pharmacology (Or)	UEC	AC	3	1		4	4
2513PY75	Advanced Instrumentation Techniques (Or)	UEC	AC	3	1		4	4
2513PY76	Dietary Supplements and Nutraceuticals (Or)	UEC	AC	3	1		4	4
2513PY77	Pharmaceutical Product Development	UEC	AC	3	1		4	4
2513PY78	Project Work	PROJ	AC				6	12
2513PY79	Student Activity Based Learning	AEC	AC				1	
2513PY49	Industrial Training	SI	IC					
	Total			**24**	**4**	**1**	**23**	**28**

Note: Students can register for any two courses across University Elective Courses (UEC) of Semester VIII as per the curriculum.

ASSESSMENT SCHEMES FOR CIE & SEE SEMESTER WISE

Semester I

Course code	Name of the course	CIE				SEE		Total Marks
		Continuous Mode	Internal Assessment		Total	Marks	Duration	
			Marks	Duration				
2513PY34	Human Anatomy and Physiology I– Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY37	Pharmaceutical Analysis I – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY46	Pharmaceutics I – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY39	Pharmaceutical Inorganic Chemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY30	Communication skills – Theory *	5	10	1 Hr	15	35	1.5 Hrs	50
2513PY54 / 2513PY77	Remedial Biology* (Or) Mathematics – Theory*	5	10	1 Hr	15	35	1.5 Hrs	50
2513PY35	Human Anatomy and Physiology – Practical	5	10	4 Hrs	15	35	4 Hrs	50
2513PY36	Pharmaceutical Analysis I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
2513PY45	Pharmaceutics I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
2513PY38	Pharmaceutical Inorganic Chemistry – Practical	5	10	4 Hrs	15	35	4 Hrs	50
2513PY29	Communication skills – Practical*	5	5	2 Hrs	10	15	2 Hrs	25
2513PY53	Remedial Biology – Practical*	5	5	2 Hrs	10	15	2 Hrs	25
Total		**75$/80#**	**125$/130#**	**24$/26#**	**200$/210#**	**525$/540#**	**33$/ 35#**	**725$/750#**

***** The subject experts at department level shall conduct examinations

$ Applicable ONLY for the students who studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics (RM) course**.**

Applicable ONLY for the students who studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB) course**.**

Semester II

Course code	Name of the course	CIE				SEE		Total Marks
		Continuous Mode	Internal Assessment		Total	Marks	Duration	
			Marks	Duration				
2513PY55	Human Anatomyand Physiology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY44	Pharmaceutical Organic Chemistry I – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY28	Biochemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY62	Pathophysiology– Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY31	Computer Applications in Pharmacy – Theory*	10	15	1 Hr	25	50	2 Hrs	75
2513PY33	Environmental sciences – Theory*	10	15	1 Hr	25	50	2 Hrs	75
2513PY56	Human Anatomy and Physiology II – Practical	5	10	4 Hrs	15	35	4 Hrs	50
2513PY43	Pharmaceutical Organic Chemistry I– Practical	5	10	4 Hrs	15	35	4 Hrs	50
2513PY27	Biochemistry– Practical	5	10	4 Hrs	15	35	4 Hrs	50
2513PY32	Computer Applications in Pharmacy – Practical*	5	5	2 Hrs	10	15	2 Hrs	25
	Total	**80**	**125**	**20 Hrs**	**205**	**520**	**30 Hrs**	**725**

***** The subject experts at department level shall conduct examinations

Semester III

Course code	Name of the course	CIE				SEE		Total Marks
		Continuous Mode	Internal Assessment		Total	Marks	Duration	
			Marks	Duration				
2513PY66	Pharmaceutical Organic Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY52	PhysicalPharmaceuticsI –Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY42	Pharmaceutical Microbiology – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY63	Pharmaceutical Engineering – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY65	Pharmaceutical Organic Chemistry II – Practical	5	10	4 Hr	15	35	4 Hrs	50
2513PY51	Physical Pharmaceutics I – Practical	5	10	4 Hr	15	35	4 Hrs	50
2513PY41	Pharmaceutical Microbiology – Practical	5	10	4 Hr	15	35	4 Hrs	50
2513PY64	Pharmaceutical Engineering – Practical	5	10	4 Hr	15	35	4 Hrs	50
Total		**60**	**100**	**20**	**160**	**440**	**28Hrs**	**600**

Semester IV

Course code	Name of the course	CIE				SEE		Total Marks
		Continuous Mode	Internal Assessment		Total	Marks	Duration	
			Marks	Duration				
2513PY67	Pharmaceutical Organic Chemistry III– Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY61	Medicinal Chemistry I – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY74	Physical Pharmaceutics II – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY50	Pharmacology I – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY48	Pharmacognosy I – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY59	Medicinal Chemistry I – Practical	5	10	4 Hr	15	35	4 Hrs	50
2513PY73	Physical Pharmaceutics II – Practical	5	10	4 Hrs	15	35	4 Hrs	50
2513PY49	Pharmacology I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
2513PY47	Pharmacognosy I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
Total		**70**	**115**	**21 Hrs**	**185**	**515**	**31 Hrs**	**700**

Semester V

Course code	Name of the course	CIE				SEE		Total Marks
		Continuous Mode	Internal Assessment		Total	Marks	Duration	
			Marks	Duration				
2513PY60	Medicinal Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY58	Industrial PharmacyI– Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY71	Pharmacology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY69	Pharmacognosy II – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY40	Pharmaceutical Jurisprudence – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY57	Industrial PharmacyI– Practical	5	10	4 Hr	15	35	4 Hrs	50
2513PY70	Pharmacology II – Practical	5	10	4 Hr	15	35	4 Hrs	50
2513PY68	Pharmacognosy II – Practical	5	10	4 Hr	15	35	4 Hrs	50
Total		**65**	**105**	**17 Hr**	**170**	**480**	**27 Hrs**	**650**

Semester VI

Course code	Name of the course	CIE				SEE		Total Marks
		Continuous Mode	Internal Assessment		Total	Marks	Duration	
			Marks	Duration				
2513PY14	Medicinal Chemistry III – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY22	Pharmacology III – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY10	Herbal Drug Technology – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY02	Biopharmaceutics and Pharmacokinetics – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY18	Pharmaceutical Biotechnology– Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY76	Quality Assurance– Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY15	Medicinal chemistry III – Practical	5	10	4 Hrs	15	35	4 Hrs	50
2513PY21	Pharmacology III – Practical	5	10	4 Hrs	15	35	4 Hrs	50
2513PY09	Herbal Drug Technology – Practical	5	10	4 Hrs	15	35	4 Hrs	50
Total		**75**	**120**	**18 Hrs**	**195**	**555**	**30 Hrs**	**750**

Semester VII

Course code	Name of the course	CIE				SEE		Total Marks
		Continuous Mode	Internal Assessment		Total	Marks	Duration	
			Marks	Duration				
2513PY13	Instrumental Methods of Analysis – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY11	Industrial Pharmacy – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY72	Pharmacy Practice – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY16	Novel Drug Delivery System – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY12	Instrumental Methods of Analysis – Practical	5	10	4 Hrs	15	35	4 Hrs	50
2513PY75	Practice School*	25	-	-	25	125	5 Hrs	150
Total		**70**	**70**	**8Hrs**	**140**	**460**	**21 Hrs**	**600**

***** The subject experts at department level shall conduct examinations

Semester VIII

Course code	Name of the course	CIE				SEE		Total Marks
		Continuous Mode	Internal Assessment		Total	Marks	Duration	
			Marks	Duration				
2513PY03	Biostatistics and Research Methodology – Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY26	Social and Preventive Pharmacy– Theory	10	15	1 Hr	25	75	3 Hrs	100
2513PY17	Pharma Marketing Management (Or)	10	15	1 Hr	25	75	3 Hrs	100
2513PY20	Pharmaceutical Regulatory Science (Or)	10	15	1 Hr	25	75	3 Hrs	100
2513PY23	Pharmacovigilance (Or)	10	15	1 Hr	25	75	3 Hrs	100
2513PY25	Quality Control and Standardization of Herbals (Or)	10	15	1 Hr	25	75	3 Hrs	100
2513PY05	Computer Aided Drug Design (Or)	10	15	1 Hr	25	75	3 Hrs	100
2513PY04	Cell and Molecular Biology	10	15	1 Hr	25	75	3 Hrs	100
2513PY06	Cosmetic Science (Or)	10	15	1 Hr	25	75	3 Hrs	100
2513PY08	Experimental Pharmacology (Or)	10	15	1 Hr	25	75	3 Hrs	100
2513PY01	Advanced Instrumentation Techniques (Or)	10	15	1 Hr	25	75	3 Hrs	100
2513PY07	Dietary Supplements and Nutraceuticals (Or)	10	15	1 Hr	25	75	3 Hrs	100
2513PY19	Pharmaceutical Product Development	10	15	1 Hr	25	75	3 Hrs	100
2513PY24	Project Work	-	-	-	-	150	4 Hrs	150
Total		**40**	**60**	**4 Hrs**	**100**	**450**	**16 Hrs**	**550**

SYLLABUS

SEMESTER I

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HUMAN ANATOMY AND PHYSIOLOGY-I (Theory)

Subject Code: 2513PY01

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

COB1: Explain the gross morphology, structure & functions of various organs of the human body.

COB2: Describe the various homeostatic mechanisms and their imbalances.

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

COB4: Perform the various experiments related to special senses and nervous system.

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

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

CO1: Demonstrate human body, Cellular level of organization, Tissue level of organization.

CO2: Explain Integumentary system, skeletal system & joints.

CO3: Describe about Blood components.

CO4: Discuss about the lymphatic system.

CO5: Describe about Peripheral nervous system& Special senses.

CO6: Describe about Cardiovascular system.

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	1
CO2	2	1
CO3	2	2
CO4	2	2
CO5	2	2
CO6	2	3

Course Content **45 Hours**

Unit I **10 hours**

Introduction to human body

Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.

Cellular level of organization

Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact- dependent b) Paracrine c) Synaptic d) Endocrine

Tissue level of organization

Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.

Unit II **10 hours**

Integumentary system

Structure and functions of skin

Skeletal system

Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system.

Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction.

Joints

Structural and functional classification, types of joints movements and its articulation

Unit III **10 hours**

Body fluids and blood

Body fluids, composition and functions of blood, haemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo-endothelial system.

Lymphatic system

Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system

Unit IV **08 hours**

- **Peripheral nervous system:**

Classification of peripheral nervous system: Structure and functions of sympathetic and

parasympathetic nervous system.

Origin and functions of spinal and cranial nerves.

- **Special senses**

Structure and functions of eye, ear, nose and tongue and their disorders.

Unit V **07 hours**

- **Cardiovascular system**

Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heartbeat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.

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 ofMedicalPhysiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. HumanPhysiology (vol1 and 2) byDr. C.C. Chatterrje, Academic Publishers Kolkata

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/

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HUMAN ANATOMY AND PHYSIOLOGY-I (Practical)

Subject Code: 2513PY08

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

COB1: Explain the gross morphology, structure and functions of various organs of the human body.

COB2: Describe the various homeostatic mechanisms and their imbalances.

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

COB4: Perform the various experiments related to special senses and nervous system.

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

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

CO1: Demonstration about microscope.

CO2: Demonstration about tissues and bones.

CO3: Demonstration about haemocytometry.

CO4: Calculation of WBC, RBC Count.

CO5: Determination of bleeding time, clotting time, Hemoglobin content, ESR.

CO6: Assess of heart rate, pulse rate and B.P.

Mapping of Course Outcomes with Program Outcomes:

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

Course Content **4 Hours/week**

List of Experiments:

Expt. No	Title	CO
1.	Study of compound microscope.	CO1
2.	Microscopic study of epithelial and connective tissue	CO1
3.	Microscopic study of muscular and nervous tissue	CO1
4.	Identification of axial bones	CO2
5.	Identification of appendicular bones	CO2
6.	Introduction to hemocytometry.	CO3
7.	Enumeration of white blood cell(WBC) count	CO4
8.	Enumeration of total red blood corpuscles (RBC) count	CO4
9.	Determination of bleeding time	CO5
10.	Determination of clotting time	CO5
11.	Estimation of haemoglobin content	CO5
12	Determination of blood group	CO5
13.	Determination of erythrocyte sedimentation rate (ESR).	CO5
14	Determination of heart rate and pulse rate.	CO6
15	Recording of blood pressure	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

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3	1	0	4

PHARMACEUTICAL ANALYSIS –I (Theory)

Subject Code: 2513PY02

Course Objectives: Upon completion of the course, the student shall be able to
COB1: Understand the principles of volumetric and electro chemical analysis
COB2: Carryout various volumetric and electrochemical titrations
COB3: Develop analytical skills

Course Outcomes: At the end of the course, the student will be able to:
CO1: Describe different techniques of analysis, Errors, Sources, errors, minimizing errors, accuracy, and precision. Sources of impurities & limit tests.
CO2: Explain Acid base titration, Non aqueous, Karl fisher titration
CO3: Determine about Precipitation & Complexometric titration, gravimetric analysis, diazotisation titration.
CO4: Assemble the procedure for gravimetric analysis
CO5: Recommend the Redox titrations Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, and Titration with potassium iodate.
CO6: Classify the Electrochemical methods of analysis, Conductometric titrations, Potentiometry, Polarography

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		2
CO2	3	2	2						3		2
CO3	3	2	2						3		2
CO4	3	2	2						3		2
CO5	3	2	2						3		2
CO6	3	2	2						3		2

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **45 Hours**

UNIT-I **10 Hours**

(a) Pharmaceutical analysis- Definition and scope

i) Different techniques of analysis

ii) Methods of expressing concentration

iii) Primary and secondary standards.

iv) Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate

(b) Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures

(c) Pharmacopoeia, Sources of impurities in medicinal agents, limit tests.

UNIT-II **10 Hours**

- **Acid base titration:** Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves
- **Non aqueous titration:** Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl.
- Determination of moisture content by Karl fisher titration.

UNIT-III **10 Hours**

- **Precipitation titrations:** Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.
- **Complexometric titration:** Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.
- **Gravimetry:** Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.
- Basic Principles, methods and application of diazotisation titration.

UNIT-IV **08 Hours**

Redox titrations

(a) Concepts of oxidation and reduction

(b) **Types of redox titrations (Principles and applications) :** Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate

UNIT-V **07 Hours**

Electrochemical methods of analysis

- **Conductometry:** Introduction, Conductivity cell, Conductometric titrations, applications.
- **Potentiometry :** Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications.
- **Polarography :** Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications

Text Books:

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis

Reference Books:

1. P. Gundu Rao, Inorganic Pharmaceutical Chemistry
2. Bentley and Driver's Textbook of Pharmaceutical Chemistry
3. John H. Kennedy, Analytical chemistry principles
4. Indian Pharmacopoeia.

Web Links:

W1:https://www.pharmaguideline.com/2021/10/preparation-and-standardization-of-solutions.html

W2: https://www.pharmaguideline.com/2011/09/water-content-determination-by-karl.html

W3: https://www.sth.nhs.uk/clientfiles/File/AP%20and%20%20HF%202019.pdf

W4:https://www.pharmaguideline.com/2021/10/basic-principles-methods-and-application-of-diazotization-titration.html

W5:https://www.pharmaguideline.com/2021/10/cerimetry-iodimetry-iodometry-bromometry-dichrometry.html#:~:text=A%20dichromatic%20titration%20is%20one,estimated%20with%20sodium%20dichromate%20solution.

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PHARMACEUTICAL ANALYSIS -I (Practical)

Subject Code: 2513PY09

Course Objectives: Upon completion of the course, the student shall be able to
COB1: Understand the principles of volumetric and electro chemical analysis
COB2: Carryout various volumetric and electrochemical titrations
COB3: Develop analytical skills

Course Outcomes: At the end of the course, student will be able to
CO1: Identify the unknown impurities in the sample by performing the Limit Tests of Chlorides, Sulphates, Iron, and Arsenic.
CO2: Demonstrate the preparation and standardization of Sodium hydroxide, Sulphuric acid, Sodium thiosulfate, Potassium permanganate, Ceric ammonium sulphate.
CO3: Analyse unknown samples by Acid- Base titrations.
CO4: Analyse unknown samples by Cerimetry, Iodometry, complexometric titrations
CO5: Analyse the concepts of Permangometry, non-aqueous titration, precipitation, back titrations.
CO6: Determination of Normality by electro-analytical methods.

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	1	2	2				1
CO2	3	2	2	3	1	2	2				1
CO3	3	2	2	3	1	2	2				1
CO4	3	2	2	3	1	2	2				1
CO5	3	2	2	3	1	2	2				1
CO6	3	2	2	3	1	2	2				1

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **4 Hours/week**

List of Experiments:

Expt. 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 Arsenic	CO1
5.	Preparation and standardization of Sodium hydroxide	CO2
6.	Preparation and standardization of Sulphuric acid	CO2
7.	Preparation and standardization of Sodium thiosulfate	CO2
8.	Preparation and standardization of Potassium permanganate	CO2
9.	Preparation and standardization of Ceric ammonium sulphate	CO2
10.	Assay of Ammonium chloride by acid base titration	CO3
11.	Assay of Ferrous sulphate by Cerimetry	CO4
12	Assay of Copper sulphate by Iodometry	CO4
13.	Assay of Calcium gluconate by complexometry	CO4
14	Assay of Hydrogen peroxide by Permanganometry	CO5
15	Assay of Sodium benzoate by non-aqueous titration	CO5
16	Assay of Sodium Chloride by precipitation titration	CO5
17	Assay of Zinc oxide by back titration	CO5
18	Conductometric titration of strong acid against strong base	CO6
19	Conductometric titration of strong acid and weak acid against strong base	CO6
20	Potentiometric titration of strong acid against strong base	CO6

Text Books:

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis

Reference Books:

1. P. Gundu Rao, Inorganic Pharmaceutical Chemistry
2. Bentley and Driver's Textbook of Pharmaceutical Chemistry
3. John H. Kennedy, Analytical chemistry principles

Web Links:

W1: https://www.pharmaguideline.com/2021/10/limit-tests.html
W2: https://www.pharmaguideline.com/2021/10/estimation-of-sodium-benzoate-and-ephedrine-hydrochloride.html
W3: https://pharmacyinfoline.com/conductometric-titration-strong-acid-strong-base/
W4: https://www.pharmaguideline.com/2021/10/theory-involved-in-titrations-of-acids-bases.html
W5: https://pharmacyinfoline.com/assay-of-ferrous-sulphate-ip/

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3	1	0	4

PHARMACEUTICS –I (Theory)

Subject Code: 2513PY03

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

COB1: Know the history of profession of pharmacy.

COB2: Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations.

COB3: Understand the professional way of handling the prescription.

COB4: Preparation of various conventional dosage forms.

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

CO1: Enumerate the history of profession of pharmacy, different dosage forms , professional way of handling the prescription and Pharmacopoeias

CO2: Compute dose calculation for pediatrics based on different factors.

CO3: Explain the basics of pharmaceutical calculations in weights and measures ,excipients used in different dosage forms and solubility enhancing techniques.

CO4: Illustration of various conventional dosage forms and their stability studies.

CO5: Design the Preparation of semisolid dosage forms for body cavity, evaluations and pharmaceutical incompatibilities.

CO6: Assess the dermal penetration mechanisms of drugs, excipients used in semisolids, various factors affecting drug absorption their preparation methods and evaluation studies.

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		2

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **45 Hours**

UNIT-I **10 Hours**

Historical background and development of profession of pharmacy: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.

Dosage forms: Introduction to dosage forms, classification and definitions

Prescription: Definition, Parts of prescription, handling of Prescription and Errors in prescription.

Posology: Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area

UNIT-II **10 Hours**

Pharmaceuticalcalculations: Weights and measures – Imperial & Metric system,

Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.

Powders: Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.

Liquid dosage forms: Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques

.UNIT-III **10 Hours**

Monophasic liquids: Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.

Biphasic liquids:

Suspensions: Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.

Emulsions: Definition, classification, emulsifying agent, test for the identification of type of

Emulsion, Methods of preparation & stability problems and methods to overcome.

UNIT-IV **08 Hours**

Suppositories: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.

Pharmaceutical incompatibilities: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.

UNIT-V **07 Hours**

Semisolid dosage forms: Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms

Text Books:

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 Books:

1. M.E. Aulton, Pharmaceutics, The Science& Dosage Form Design, Churchill Livingstone, Edinburgh
2. Lachmann. Theory and Practice of Industrial Pharmacy,Lea& Febiger Publisher, The University of Michigan
3. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi

Web Links:

W1:https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/suppository

W2: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6548782/

W3:https://www.pharmaguideline.com/2021/10/definition-classification-physical-chemical-therapeutic-incompatibilities.html

W4:https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/semisolid-dosage%20form.

W5:https://www.researchgate.net/figure/Mechanism-of-absorption-of-semisolids_fig1_320923384

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PHARMACEUTICS-I (Practical)

Subject Code: 2513PY10

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

COB1: Understand the basics of different dosage forms,

COB2: Learn various pharmaceutical calculations.

COB3: Understand the professional way of handling the prescription.

COB4: Preparation of various conventional dosage forms.

COB5: Familiarize with the selection and role of excipients

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

CO1: Explains the preparation of monophasic liquid dosage forms for internal use.

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

CO3: Evaluate the preparation of Biphasic liquid dosage forms for internal & external use.

CO4: Set up the preparation and dispensing methods for solid dosage forms like various powders.

CO5: Formulate the preparation of effervescent powders.

CO6: Experiment the various semisolid dosage forms (ointments, creams, gels, suppositories)

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	3	1
CO2	3	1
CO3	3	1
CO4	3	1
CO5	3	1
CO6	3	1

Course Content **4Hours/week**

List of Experiments:

Expt. No	Title	CO
1	**Syrups** a) Syrup IP'66 b) Compound syrup of Ferrous Phosphate BPC'68	CO1
2	**Elixirs** a) Piperazine citrate elixir b) Paracetamol pediatric elixir	CO1
3	**Linctus** a) Terpin Hydrate Linctus IP'66 4. Solutions b) Iodine Throat Paint (Mandles Paint)	CO1 & CO2
4	**Solutions** a) Strong solution of ammonium acetate b) Cresol with soap solution c) Lugol's solution	CO2
5	**Suspensions** a) Calamine lotion b) Magnesium Hydroxide mixture c) Aluminimum Hydroxide gel	CO1 & CO2
6	**Emulsions** a) Turpentine Liniment b) Liquid paraffin emulsion	CO3
7	**Powders and Granules** a) ORS powder (WHO) b) Effervescent granules c)Dusting powder d)Divded Powders	CO4 & CO5
8	**Suppositories** a) Glycero gelatin suppository b) Coca butter suppository c) Zinc Oxide suppository	CO6
9	**Semisolids** a) Sulphur ointment b) Non staining-iodine ointment with methyl salicylate c) Carbopal gel	CO6
10	**Gargles and Mouthwashes** a) Iodine gargle b) Chlorhexidine mouthwash	CO2

Text Books:

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 Books:

1. M.E. Aulton, Pharmaceutics, The Science& Dosage Form Design, Churchill Livingstone, Edinburgh

2. Lachmann. Theory and Practice of Industrial Pharmacy,Lea& Febiger Publisher, The University of Michigan

3. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi

Web Links:

W1:https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/suppository

W2:https://pharmainfosource.com/new-equipment/syrup-area

W3:https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/semisolid-dosage%20form

W4: https://www.medicine.mcgill.ca/physio/vlab/bloodlab/ESR.htm

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PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)

Subject Code: 2513PY04

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

COB1: Know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals

COB2: Understand the medicinal and pharmaceutical importance of inorganic compounds

Course outcome: At the completion of this course the student will able to

CO1: Discuss the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals.

CO2: Describe Major extra and intracellular electrolytes: Functions of major physiological ions.

CO3: Summarize the concept of buffers and Functions of major physiological ions.

CO4: Classify the gastrointestinal agents, cathartics and anti-microbial agents.

CO5: Characterize - Expectorants, Emetics, Poison and Antidote and Astringents

CO6: Explain the Radio activity, Measurement of radioactivity, Storage conditions, precautions & pharmaceutical application of radioactive substances.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **45 Hours**

UNIT **10 Hours**

Impurities in pharmaceutical substances: History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate
General methods of preparation, assay for the compounds superscripted with **asterisk (*),** properties and medicinal uses of inorganic compounds belonging to the following classes

UNIT II **10 Hours**

- **Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.

- **Major extra and intracellular electrolytes**: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.

- **Dental products**: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenolcement.

UNIT III **10 Hours**

- **Gastrointestinal agents**

Acidifiers: Ammoniumchloride* and Dil. HCl

Antacid: Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture

Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite

Antimicrobials: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations

UNIT IV **08 Hours**

Miscellaneous compounds

Expectorants: Potassium iodide, Ammonium chloride*. **Emetics**: Copper sulphate*, Sodium potassium tartarate **Haematinics:** Ferrous sulphate*, Ferrous gluconate

Poison and Antidote: Sodium thiosulphate*, Activated charcoal, Sodiumnitrite333

Astringents: Zinc Sulphate, Potash Alum

UNIT V **07 Hours**

Radiopharmaceuticals: Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half-life, radio isotopes and study of radio isotopes - Sodium iodide I^{131}, Storage conditions, precautions & pharmaceutical application of radioactive substances.

Text Books:

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis

Reference Books:

1. Bentley and Driver's Textbook of Pharmaceutical Chemistry
2. Anand & Chatwal, Inorganic Pharmaceutical Chemistry
3. Indian Pharmacopoeia

Web Links:

W1.https://chemed.chem.purdue.edu/genchem/topicreview/bp/ch12/trans.php
W2.https://pubs.acs.org/inorganic-chemistry?
W3.https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Introduction_toInorganicChemistry_(Wikibook)
W4.https://www.sciencedirect.com/topics/earth-and-planetary-sciences/inorganic-chemistry
W5.https://en.m.wikibooks.org/wiki/Introduction_to_Inorganic_Chemistry

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PHARMACEUTICAL INORGANIC CHEMISTRY-(Practical)

Course code: 2513PY11

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

COB1: Know the sourcesof impurities
COB2: Know the methods to determine the impurities in Inorganic drugs and pharmaceuticals
COB3: Understand the medicinaland pharmaceutical importance of inorganic 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, drug and pharmaceuticals
CO3: Differentiate physiological ions.
CO4: Categorize inorganic pharmaceuticals as gastro intestinal agents
CO5: Elaborate 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						3		3	1	3
CO2	3					1	3			1	3
CO3	3			1			3			1	3
CO4	3			3			3				3
CO5	3						3	3	2	2	3
CO6	3					1	3	1			3

Mapping of Course Outcomes with Program-Specific Outcomes:

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

Course Content **4 Hours / Week**

List of Experiments:

Expt. No	Title	CO
1	Limit test for Chlorides and Sulphates	CO1
2	Limit test for Iron	CO1
3	Limit test for Heavy metals	CO1
4	Limit test for Lead	CO1
5	Limit test for Arsenic	CO1
6	Modified limit test for Chlorides and Sulphates	CO2
7	Identification tests for Magnesium hydroxide	CO2
8	Identification tests for Ferrous sulphate	CO2
9	Identification tests for Sodium bicarbonate	CO2
10	Identification tests for Calcium gluconate	CO2
11	Identification tests for Copper sulphate	CO2
12	Swelling power of Bentonite	CO3
13	Neutralizing capacity of aluminium hydroxide gel	CO4
14	Determination of potassium iodate and iodine in potassiumIodide	CO5
15	Preparation of inorganic pharmaceuticals Boric acid	CO6
16	Preparation of Potash alum	CO6
17	Preparation ofFerrous sulphate	CO6

Text Books:

1. A.H. Beckett & J.B. Stenlake's.
2. Practical Pharmaceutical Chemistry Vol I & II.

Reference Books:

1. Stahlone Press of University of London, 4th edition. A.I. Vogel.
2. Inorganic Pharmaceutical Chemistry, 3rd Edition M.LSchroff.
3. Inorganic Pharmaceutical Chemistry Bentley and Driver's Textbook of Pharmaceutical Chemistry

Web Links:

W1 https://learnaboutpharma.com/limit-test-for-arsenic-principle-gutzeit-apparatus-procedure-and-notes/
W2 https://chrominfo.blogspot.com/2021/10/identification-tests-of-magnesium.html
W3 https://www.scribd.com/document/718189565/SWELLING-POWER-IN-BENTONITE
W4 https://cdn.who.int/media/docs/default-source/medicines/pharmacopoeia/omitted-monographs/aluminium_hydroxide.pdf?sfvrsn=63b28b7d_5
W5 https://courseware.cutm.ac.in/wp-content/uploads/2020/06/Preparation-of-Boric-Acid.pdf

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COMMUNICATION SKILLS (Theory)

Subject Code: 2513PY05

Course Objective: Uponcompletion ofthe course the student shall be able to

COB1: Understand the behavioral needs for a pharmacist to function effectively in the areas of pharmaceutical operation
COB2: Communicate effectively (Verbal and Non-Verbal)
COB3: Effectively manage the team as a team player
COB4: Develop interview skills
COB5: Develop Leadership qualities and essentials

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

CO1: Make use of the concepts to communicat confidently and competently in English Language in all spheres.
CO2: Evaluate make effective use of non-verbal communication in all situations and contexts to enhance effective communication in allaspects.
CO3: Use listening skills to create more effective, productive professional and personal relationships.
CO4: Illustrate the importance of interview skills for personal and professional growth.
CO5: Make design use of effective delivery strategies for giving oral presentations.
CO6: Understand the key skills and behaviour required to facilitate a group discussion.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course content: **30 Hours**

UNIT – I **07 Hours**

Communication Skills: Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context

Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers

Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment

UNIT – II **07 Hours**

Elements of Communication: Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication
Communication Styles: Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style

UNIT – III **07 Hours**

Basic Listening Skills: Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations

Effective Written Communication: Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication

Writing Effectively: Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message

UNIT – IV **05 Hours**

Interview Skills: Purpose ofan interview, Do's and Dont's ofan interview

Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery

UNIT – V **04 Hours**

Group Discussion: Introduction, Communication skills in group discussion, Do's and Dont's of group discussion

Text Books:

1. Communication Skills in Pharmacy Practice by Robert S. Beardsley, Carole Kimberlin, and William N. Tindall (5th Edition, Lippincott, Williams & Wilkins)
2. Effective Communication by John Adair (4th Edition, Pan Macmillan, 2009)

References:

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdit ion, Oxford Press, 2011
3. Organizational Behaviour, Stephen.P. Robbins, 1stEdition, Pearson, 2013

Weblinks:

W1: www.cambridgeone.org

W2: https://www.britishcouncil.in/english/online

W3: www.englishmedialab.com

W4: https://www.indeed.com/career-advice/career-development/dos-and-donts-of-group-discussion

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0	0	2	1

COMMUNICATION SKILLS (Practical)

SUBJECT CODE: 2513PY12

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

COB1: Understand the behavioral needs for a pharmacist to function effectively in the areas of pharmaceutical operation
COB2: Communicate effectively (Verbal and Non-Verbal)
COB3: Effectively manage the team as a team player
COB4: Develop interview skills
COB5: Develop Leadership qualities and essentials

Course outcomes: At the end of the course, the student will be able to:
CO1: Demonstrate Basic communication covering the topics like Meeting People Asking Questions
CO2: Demonstrate Basic communication covering the topics like Making Friends
CO3: Write about What did you do?Do's and Don'ts
CO4: Explain nouns, Pronunciations like Consonant and vowel Sounds Describe Listening Comprehension / Direct and Indirect Speech and Figures of Speech
CO5: DemonstrateEffective Communication Writing Skills Effective Writing.
CO6: Develop Interview Handling Skills E-Mail etiquette Presentation Skills

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **2 Hours / Week**

List of Experiments:

Expt. No	Title	CO
1.	Demonstrate Basic communication covering the topics like Meeting People, and Asking Questions	**CO1**
2.	Demonstrate Basic communication covering the topics like Making Friends	**CO2**
3.	What did you do? Do's and Dont's	**CO3**
4.	Explain nouns, Pronunciations like Consonant and vowel Sounds, Describe Listening Comprehension / Direct and Indirect Speech and Figures of Speech	**CO4**
5.	Demonstrate Effective Communication, Writing Skills, Effective Writing	**CO5**
6.	Develop Interview Handling Skills, E-Mail etiquette, Presentation Skills	**CO6**

Text Books:

1. Communication Skills for Professionals, Nira Konar, 2021.
2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdit ion, Oxford Press, 2011

References:

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
2. Organizational Behaviour, Stephen.P. Robbins, 1stEdition, Pearson, 2013
3. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011

Weblinks:

W1: www.cambridgeone.org

W2: https://www.britishcouncil.in/english/online
W3: www.englishmedialab.com
W4: https://www.coursera.org/in/articles/communication-effectiveness

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REMEDIAL BIOLOGY (Theory)

Subject Code: 2513PY06

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

COB1: Know the classification and salient features of five kingdoms of life.

COB2: Understand the basic components of anatomy & physiology of plant.

COB3: Know understand the basic components of anatomy & physiology animal with special reference to human.

COB4: Understand and explain the principles of biological evolution

COB5: Examine the structure and types of inflorescence and modes of pollination

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

CO1: Demonstrate about Cell biology (Basic Nature of Plant cell and Animal cell)
CO2: Classification System of both Plants & Animals.
CO3: Determine about various tissue system and organ system in plant and animals.
CO4: Explain about theory of evolution.
CO5: Assess the Inflorescence and Pollination of flowers.
CO6: Describe about Anatomy and Physiology of plants and animals.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program-Specific Outcomes:

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

Course Content **30 Hours**

UNIT I **07 Hours**

Living world:

- Definition and characters of living organisms
- Diversity in the living world
- Binomial nomenclature
- Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus, Morphology of Flowering plants
- Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed.
- General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones.

UNIT II **07 Hours**

Body fluids and circulation :

- Composition of blood, blood groups, coagulation of blood
- Composition and functions of lymph
- Human circulatory system
- Structure of human heart and blood vessels
- Cardiac cycle, cardiac output and ECG Digestion and Absorption
- Human alimentary canal and digestive glands
- Role of digestive enzymes
- Digestion, absorption and assimilation of digested food Breathing and respiration
- Human respiratory system
- Mechanism of breathing and its regulation
- Exchange of gases, transport of gases and regulation of respiration
- Respiratory volumes

UNIT III **07 Hours**

Excretory products and their elimination:

- Modes of excretion
- Human excretory system- structure and function
- Urine formation
- Rennin angiotensin system Neural control and coordination
- Definition and classification of nervous system
- Structure of a neuron
- Generation and conduction of nerve impulse
- Structure of brain and spinal cord
- Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata Chemical coordination and regulation
- Endocrine glands and their secretions
- Functions of hormones secreted by endocrine glands Human reproduction
- Parts of female reproductive system
- Parts of male reproductive system
- Spermatogenesis and Oogenesis
- Menstrual cycle

UNIT IV **05 Hours**

Plants and mineral nutrition:

- Essential mineral, macro and micronutrients
- Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation Photosynthesis
- Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.

UNIT V **04 Hours**

Plant Respiration: Glycolysis, fermentation (anaerobic). Plant growth and development

- Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators Cell - The unit of life
- Structure and functions of cell and cell organelles. Cell division Tissues
- Definition, types of tissues, location and functions.

Text Books:

1. Text book of Biology by S. B. Gokhale
2. 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

Web Links:

W1: https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/suppository

W2: https://www.ncbi.nlm.nih.gov/books/NBK513247/

W3: https://www.brainandspine.org.uk/anatomy-of-the-brain-and-spine/

W4: https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/biological-nitrogen-fixation.

W5: https://www.britannica.com/science/tissue

L	T	P	C
0	0	2	1

REMEDIAL BIOLOGY (Practical)

SUBJECT CODE: 2513PY13

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

COB1: Know the classification and salient features of five kingdoms of life.
COB2: Understand the basic components of anatomy & physiology of plant.
COB3: Know understand the basic components of anatomy & physiology animal with special reference to human.

Course Outcomes: At the end of the course, student will be able to
CO1: Demonstrate about a) Study of Microscope b) Section cutting techniques c) Mounting and staining d) Permanent slide preparation.
CO2: Analyze cell and its inclusions
CO3: Set up Detailed study of frog by using computer models
CO4: Operate Microscopic study and identification of tissues pertinent to Stem, Root Leaf, seed, fruit and flowers
CO5: Identify bones
CO6: Determination of blood group, blood pressure, tidal volume

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program-Specific Outcomes:

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

Course Content **2 Hours / Week**

LIST OF EXPERIMENTS:

EXP NO	TITLE	CO
1.	Introduction to experiments in biology, a) Studyof Microscope b) Section cutting techniques c) Mounting and staining d) Permanent slide preparation.	**CO1**
2.	Study ofcell and its inclusions	**CO2**
3.	StudyofStem, Root, Leaf, seed, fruit, flower and their modifications	**CO2**
4.	Detailed studyof frog byusing computer models	**CO3**
5.	Microscopic studyand identification of tissues pertinent to Stem, Root Leaf, see fruit and flowers	**CO4**
6.	Identification of bones	**CO5**
7.	Determination ofblood group	**CO6**
8.	Determination ofblood pressure	**CO6**
9.	Determination oftidal volume	**CO6**

Text Books:

1. A Manual of pharmaceutical biology practical by S.B.Gokhale, C.K.Kokate and S.P.Shriwastava.
2. Biology practical manual according to National core curriculum .Biology forum of Karnataka. Prof .M.J.H.Shafi

Reference Books:

1. Practical human anatomy and physiology. by S.R.Kale and R.R.Kale.
2. A Manual of pharmaceutical biology practical by S.B.Gokhale, C.K.Kokate and S.P.Shriwastava.
3. Biology practical manual according to National core curriculum .Biology forum of Karnataka. Prof .M.J.H.Shafi

Web Links:

W1: https://pharmacyinfoline.com/section-cutting-techniques/

W2: https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/plant-morphology

W3: https://training.seer.cancer.gov/anatomy/skeletal/classification.html

W4: https://pharmacyinfoline.com/determination-of-blood-group/

W5: https://www.ncbi.nlm.nih.gov/books/NBK482502/

L	T	P	C
2	0	0	2

Remedial Mathematics (Theory)

Subject Code: 2513PY07

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

COB1: Know the theoryand their application in Pharmacy
COB2: Solve the different types of problems by applying theory
COB3: Appreciate the important application of mathematics in Pharmacy

Course Outcomes: At the end of the course, student will be able to
CO1: Apply the fractions, logarithms, functions.
CO2: Determine the regarding matrices and determinants.
CO3: Solve about calculus and differentiation.
CO4: Solve the analytical geometry, straight line and integration.
CO5: Integrate the differential equations.
CO6: Determination of blood group, blood pressure, tidal volume

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course content: **30 Hours**

UNIT – I **06 Hours**

- **Partial fraction**

Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics

- **Logarithms**

Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.

- **Function**:

Real Valued function, Classification of real valued functions,

- **Limits and continuity** :

Introduction , Limit ofa function, Definition of limit ofa function (- definition),

$$\lim_{x \to a} \frac{x^n - a^n}{x - a} = n.\, a^{n-1}, \quad \lim_{\theta \to 0} \frac{\sin \theta}{\theta} = 1$$

UNIT –II **06 Hours**

- **Matrices and Determinant:**

Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants , Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix , Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley –Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations

UNIT – III **06 Hours**

- **Calculus**

Differentiation$_x$: Introductions, Derivative of a function, Derivative of a $_e$constant, Derivative of a product of a constant and a function , Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – **Without Proof**, Derivative of x^n w.r.t x, where n is any rational number, Derivative of e^x,, Derivative of log x ,

Derivative of a, Derivative of trigonometric functions from first principles **(without Proof)**, Successive Differentiation, Conditions to be a maximum or minimum at a point.

UNIT – IV **06 Hours**

- **Analytical Geometry**

Introduction: Signs ofthe Coordinates, Distance formula,

Straight Line : Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line

Integration:

Introduction, Definition, Standard formulae, Rules of integration , Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application

UNIT-V **06 Hours**

- **Differential Equations** : Some basic definitions, Order and degree, Equations in separable form , Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations
- **Laplace Transform** : Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, Application in solving Chemical kinetics and Pharmacokinetics equations

Text Books:

1. Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H.
2. Higher Engineering Mathematics by Dr.B.S.Grewal

Reference Books:

1. DifferentialCalculus by Shanthinarayan
2. Integral Calculus by Shanthinarayan
3. Higher Engineering Mathematics, B.V. Ramana, McGraw-Hill Education, 11'th Ed.,

Web Links:

W1 https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:logarithms
W2 https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:logarithms
W3 https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions
W4 https://tutorial.math.lamar.edu/Classes/LinAlg/LinAlg.aspx
W5 https://www.khanacademy.org/math/differential-calculus

SEMESTER II

L	T	P	C
3	1	0	4

HUMAN ANATOMY AND PHYSIOLOGY-II (Theory)

Subject Code: 2513PY14

Course Objective: Uponcompletion of the subject student shall be able to

COB1: Explain the gross morphology, structure and functions of various organs of the human body.

COB2: Describe the various homeostatic mechanisms and their imbalances.

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

COB4: Perform the hematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time etc., and also record blood pressure, heart rate, pulse and respiratory volume.

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

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: Demonstrate about Nervous system and its functions in detail

CO2: Explain about digestive system and energetic in the human body

CO3: Explain about respiratory system its role in the human body

CO4: Describe about urinary system and its functions in the human body

CO5: Describe about endocrine system its role in the human body

CO6: Explain about reproductive system and genetics and their significance in the human body

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program-Specific Outcomes:

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

COURSE CONTENT: **45 Hours**

Unit I **10 hours**

Nervous system

Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters. Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid. structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity)

Unit II **06 hours**

Digestive system

Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT.

Energetics Formation and role of ATP, Creatinine Phosphate and BMR.

Unit III **10 hours**

Respiratory system

Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods.

Urinary system

Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.

Unit IV **10 hours**

Endocrine system

Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.

Unit V **09 hours**

Reproductive system Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition

Introduction to genetics Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance.

Text Books:

1. Text book of Medical Physiology- Arthur C,GuytonandJohn.E. Hall. Miamisburg, OH, U.S.A.
2. Textbook of Human Histology by Inderbir Singh, Jaypeebrothers medical publishers, New Delhi.

References 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
3. Text book of Medical Physiology- Arthur C,GuytonandJohn.E. Hall. Miamisburg, OH,

Web Links:

W1: https://my.clevelandclinic.org/health/body/21202-nervous-system

W2: https://www.britannica.com/science/human-digestive-system

W3: https://my.clevelandclinic.org/health/body/21205-respiratory-system

W4: https://en.wikipedia.org/wiki/Endocrine_system

W5: https://www.britannica.com/science/human-reproductive-system

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0	0	4	2

HUMAN ANATOMY AND PHYSIOLOGY-II (Practical)

Subject Code: 2513PY20

Course Objectives: Uponcompletion of the course the student shall be able to

COB1: Explain the gross morphology, structure and functions of various organs ofhuman body

COB2: Describe the various homeostatic mechanisms and their imbalances.

COB3: Identifythe various tissues and organs of different systems of human Body.

COB4: Perform the hematological tests like blood cell counts, hemoglobin estimation, bleeding / clotting time etc. and also record blood pressure, heart rate, pulse and respiratory;

COB5: Appreciate coordinated working pattern ofdifferent organs of each system

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

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

CO1: Demonstration about integumentary system, nervous system, endocrine system and Cranial nerves.

CO2: Analyze different types of taste, visual activity**.**

CO3: Determination of reflex activity, body temperature and feedback mechanism.

CO4: Determination of tidal and vital capacity, BMI.

CO5: Demonstration on family planning and pregnancy diagnosis

CO6: Analyze organ slides observation, total blood count by cell analyzer indifferent dosa forms.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program-Specific Outcomes:

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

Course Content: **4 Hrs/Week**

List of Experiments:

S.No	List Of Experiments	CO
1.	To studythe integumentary and special senses using specimen, models, etc.,	CO1
2.	To studythe nervous system using specimen, models, etc.,	CO1
3.	To studythe endocrine system using specimen, models, etc	CO1
4.	To demonstrate the general neurological examination	CO1
5.	To demonstratethe function of olfactory nerve	CO2
6.	To examine the different types of taste.	CO2
7.	To demonstrate the visual acuity	CO2
8.	To demonstrate the reflex activity	CO3
9.	Recording ofbody temperature	CO3
10.	To demonstrate positive and negative feedback mechanism.	CO3
11.	Determination of tidal volume and vital capacity	CO4
12.	Study of digestive, respiratory, cardiovascular systems, urinary an reproductive systems with the help of models, charts and specimens.	CO4
13.	Recording of basal mass index	CO4
14.	Study of family planning devices and pregnancy diagnosis test.	CO5
15.	Demonstration of total blood count by cell analyzer	CO6
16.	Permanent slides of vital organs and gonads.	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

References Books:

1. Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.
2. Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi.
3. Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.

Web Links:

W1:https://www.pharmaacademias.com/wp-content/uploads/2024/05/To-study-the-nervous-system-using-specimen-models-etc.pdf

W2:https://www.pharmaacademias.com/wp-content/uploads/2024/06/Demonstration-of-Olfactory-Nerve-Function-1**.**

W3: https://www.pharmaacademias.com/to-demonstrate-the-visual-acuity/

W4: https://www.pharmaacademias.com/wp-content/uploads/2024/06/To-demonstrate-positive-and-negative-feedback-mechanism.pdf

W5: https://www.pharmaacademias.com/wp-content/uploads/2024/06/Demonstration-of-Total-Blood-Count-by-Cell-Analyzer.pdf

L	T	P	C
3	1	0	3

PHARMACEUTICAL ORGONIC CHEMISTRY I (Theory)

Subject Code: 2513PY15
Course Objective: Upon completion of the subject student shall be able to
COB1: write the structure, name and the type of isomerism of the organic compound
COB2: write the reaction, name the reaction and orientation of reactions
COB3: account for reactivity/stability of compounds,
COB4: Identify/confirm the identification of organic compound

Course Outcomes: At the end of the course, the student will be able to:
CO1: Understand & Classify the of Organic Compounds Common and IUPAC systems of nomenclature of organic compounds.
CO2: Describe Hybridization, Halogenation, E1 and E2 reactions, Markownikoff's orientation, free Anti Markownikoff's orientation.
CO3: Justify the Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement
CO4: Understand SN1 and SN2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN1 versus SN2 reactions, Factors affecting SN1 and SN2 reactions
CO5: Summarize Alcohols Qualitative tests, Structure and uses of mentioned compounds
CO6: Prepare Carboxylic acids , Aliphatic amines & understand the acidity of carboxylic acids, Aliphatic amines

Mapping of Course Outcomes with Program Outcomes:

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

Course Content: **45 Hours**

UNIT-I **07 Hours**

Classification, nomenclature and isomerism Classification of Organic Compounds Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds) Structural isomerisms in organic compounds

UNIT-II **10 Hours**

Alkanes*, Alkenes* and Conjugated dienes* SP3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP2 hybridization in alkenes E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E1 verses E2 reactions, Factors affecting E1 and E2 reactions. Ozonolysis,

electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation. Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement

UNIT-III **10 Hours**

Alkyl halides* SN1 and SN2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN1 versus SN2 reactions, Factors affecting SN1 and SN2 reactions Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform. • Alcohols*- Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol.

UNIT-IV **10 Hours**

Carbonyl compounds* (Aldehydes and ketones) Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde.

UNIT-V **08 Hours**

Carboxylic acids* Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids ,amide and ester Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid

Aliphatic amines* - Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine

Text Books:
1. Vogels textbook
2. Orgonic chemistry by J. Leonard

Reference Books:
1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar, Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.

Web Links:
W1: Pharmaceutical Organic Chemistry 1 Notes pdf - Pharma Edu
W2:PharmaceuticalOrganicChemistry1:Unit1NotesBpharmaPharmdbm
W3:pharmaceutical-organic-chemistry-1EasyPharmaNotes
W4:Pharmaceuticalorganicchemistry-INotes|2ndSemester|B.Pharma
W5: Pharmaceutical Organic Chemistry 1 Notes PDF Free - MediPdf

L	T	P	C
0	0	4	2

PHARMACEUTICAL ORGONIC CHEMISTRY I (Practical)

Subject Code: 2513PY21

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

COB1: Concepts and the mechanisms for the synthetic tools in generating newer products can be correlated with novel drug design and development in future.

COB2: The mode of quality control procedures and applications of numerous organic compounds

COB3: The practical knowledge from the laboratory preparation of organic molecules and their qualitative organic analysis.

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

CO1: Assess Laboratory techniques

CO2: Demonstrate Purification techniques

CO3: Determine melting & boiling points

CO4: Identify /confirm the unknown organic compounds by using systematic qualitative analysis.

CO5: Analyse the Preparation of suitable solid derivatives from organic Compounds

CO6: Construction of molecular models

Mapping of Course Outcomes with Program Outcomes:

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

Course Content **4 Hours/week**

List of Experiments:

Expt. No	Title	CO
1.	Basic Laboratory rules & Techniques	CO1
2.	Determination of Meling point	CO2
3.	Determination of Boiling point	CO2
4.	Purification techniques	CO3
5.	Qualitative analysis for organic sample-1	CO4
6.	Qualitative analysis for organic sample-2	CO4
7.	Qualitative analysis for organic sample-3	CO4
8.	Qualitative analysis for organic sample-4	CO4
9.	Qualitative analysis for organic sample-5	CO4
10.	Qualitative analysis for organic sample-6	CO4
11.	Qualitative analysis for organic sample-7	CO4
12.	Preparation of Acetanilide	CO5
13.	Preparation of Benzoic acid from Benzaldehyde	CO5
14.	Preparation of Picric Acid	CO5
15.	Preparation of m-dinitrobenzene	CO5
16.	Preparation of Benzyl alcohol from Benzaldehyde	CO5
17.	Preparation of Dibenzalacetone from Benzaldehyde	CO5
18.	Construction of Molecular models	CO6

Text Books:

1. Vogel's Textbook of Practical Organic Chemistry (5th Edition)
2. Practical analytical chemistry by Lambert academic publishing

Reference Books:

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar, Volume-I
3. Orgonic chemistry by I L Finar

Web Links:

W1:https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(Smith)/17%3A_Carboxylic_Acids_and_the_Acidity_of_the_OH_Bond/17.01%3A_Inductive_Effects_in_Aliphatic_Carboxylic_Acids
W2: www.hrpatelpharmacy.co.in
W3: https://www.studocu.com/
W4: https://www.books.ipinnovative.com
W5: https://darshanpublishers.com/

L	T	P	C
3	1	0	4

BIOCHEMISTRY (Theory)

Subject Code: 2513PY16

Course Objectives: Upon completion of course student shell able to

COB1. Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.

COB2. Understand the metabolism of nutrient molecules in physiological and pathological conditions.

COB3. Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

Course Outcomes:

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

CO1: Describe catalytic activity of enzymes and importance of iso-enzymes in diagnosis of diseases.

CO2: Explain the metabolic process of bio-molecules in health and illness (metabolic disorders)

CO3: Determine genetic organization of mammalian genome

CO4: Classify protein synthesis: replication: mutation and repair mechanism

CO5: Conclude biochemical principles of organ function tests of kidney, liver and endocrine gland

CO6: Develop qualitative analysis and determination of bio-molecules in the body fluids.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content: **45 Hours**

UNIT I **08 Hours**

Biomolecules Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins. • Bioenergetics Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential. Energy rich compounds; classification; biological significances of ATP and cyclic AMP

UNIT II **10 Hours**

Carbohydrate metabolism Glycolysis – Pathway, energetics and significance Citric acid cycle-Pathway, energetics and significance HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency Glycogen metabolism Pathways and glycogen storage diseases (GSD) Gluconeogenesis- Pathway and its significance Hormonal regulation of blood glucose level and Diabetes mellitus • Biological oxidation: Electron transport chain (ETC) and it's mechanism.

Oxidative phosphorylation & its mechanism and substrate level phosphorylation. Inhibitors ETC and oxidative phosphorylation/Uncouplers.

UNIT III **10 Hours**

- Lipid metabolism β-Oxidation of saturated fatty acid (Palmitic acid) Formation and utilization of ketone bodies; ketoacidosis De novo synthesis of fatty acids (Palmitic acid) Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.
- Amino acid metabolism General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia) Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline Catabolism of heme; hyperbilirubinemia and jaundice

UNIT IV **10 Hours**

Nucleic acid metabolism and genetic information transfer Biosynthesis of purine and pyrimidine nucleotides Catabolism of purine nucleotides and Hyperuricemia and Gout disease Organization of mammalian genome Structure of DNA and RNA and their functions DNA replication (semi conservative model) Transcription or RNA synthesis Genetic code, Translation or Protein synthesis and inhibitors

UNIT V **07 Hours**

- Enzymes Introduction, properties, nomenclature and IUB classification of enzymes Enzyme kinetics (Michaelis plot, Line Weaver Burke plot) Enzyme inhibitors with examples Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation Therapeutic and diagnostic applications of enzymes and isoenzymes Coenzymes –Structure and biochemical

functions

Text Books:
1. Harper’s Illustrated Biochemistry, Victor W. Rodwell, David Bender, et al.
2. Lippincott's Illustrated Reviews: Biochemistry, Denise R. Ferrier

Reference Books:
1. Principles of Biochemistry by Lehninger.
2. Harper’s Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.
3. Biochemistry by Stryer.

Web Links:
W1: All Biochemistry Notes - Chemistry Notes
W2: Biochemistry : Unit 1 : Semester 2 : Bpharm - Pharmdbm
W3: BIOCHEMISTRY NOTES - BEST STUDY NOTES OF BIOCHEMISTRY
W4: Biochemistry Notes & Study Materials | EasyBiologyClass
W5: Biochemistry Notes by BiochemSerye

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BIOCHEMISTRY (Practical)

Subject Code: 2513PY22

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

COB1: Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.

COB2: Understand the metabolism of nutrient molecules in physiological and pathological conditions.

COB3: Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins

COB4: know the biochemical principles of organ function tests of kidney, liver and endocrine gland; and exocrine gland.

COB5: Perform the qualitative analysis and determination of biomolecules in the body fluids

Course Outcomes: At the end of the course, 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: Identify SGOT and SGPT in serum.

CO5: Analyse Urea, Proteins and serum bilirubin

CO6: Predict sodium, calcium and potassium in serum

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	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2
CO6	2	2

Course Content: **4Hours/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 blood sugar Folin-Wu tube method.	**CO2**
4	Determination of calcium in urine.	**CO2**
5	Quantitative estimation of urine creatinine	**CO2**
6	Quantitative estimation of urine sugar by Benedict's reagent method	**CO3**
7	Quantitative estimation of blood creatinine.	**CO3**
8	Estimation of SGOT in serum.	**CO3**
9	Preparation of Folin Wu filtrate from blood	**CO4**
10	Estimation of SGPT in serum	**CO4**
11	Estimation of Urea in Serum.	**CO4**
12	Estimation of Proteins in Serum.	**CO5**
13	Determination of serum bilirubin	**CO5**
14	Quantitative estimation of urine chlorides by Volhard's method.	**CO5**
15	Quantitative estimation of serum cholesterol by Libermann Burchard's method	**CO6**
16	Determination of Glucose by means of Glucose oxidase.	**CO6**
17	Quantitative estimation of urine calcium by precipitation method.	**CO6**
18	Enzymatic hydrolysis of Glycogen/Starch by Amylases.	**CO6**

Text Books:

1. Practical Biochemistry, Harold Varley, Alan H. Gowenlock, Maurice Bell
2. Practical Clinical Biochemistry, R. Rajagopal

Reference Books:

1. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
2. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
3. Practical biochemistry by Herold

Web Links:

W1: https://skyfox.co/wp-content/uploads/2020/12/Practical-Manual-of-Biochemistry
W2: https://www.brainkart.com/materials/biochemistry
W3: https://www.researchgate.net/publication/260182512_Practical_Manual_in_Biochemistry
W4: https://webstor.srmist.edu.in/
W5: Practical Manual in Biochemistry and Clinical Biochemistry | PDF | Ph | Kidney

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PATHOPHYSIOLOGY (THEORY)

Subject Code: 2513PY17.
Course Objectives: Upon completion of the subject student shall be able to –
COB1: 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: Discuss basic principal of cell injury and Adaptation.
CO2: Describe about the inflammation and repair.
CO3: Explain the cardiovascular system.
CO4: Summarize the Haematological diseases.
CO5: Describe the bone diseases.
CO6: Explain the Infectious diseases.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program-Specific Outcomes:

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

Course Content: **45Hours**

Unit I: **10Hours**

· Basic principles of Cell injury and Adaptation: Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury,Pathogenesis (Cell membrane\ damage, Mitochondrial damage, Ribosome damage, Nuclear damage),Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia),Cell

swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis &Alkalosis,Electrolyte imbalance.

· Basic mechanism involved in the process of inflammation and repair: Introduction, Clinical signs of inflammation, Different types of Inflammation,Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's,Mediators of inflammation,Basic principles of wound healing in in the skin,Pathophysiology of Atherosclerosis.

Unit-II **10Hours**

Cardiovascular System: Hypertension, congestive heart failure, ischemic heart disease (angina,myocardial infarction, atherosclerosis and arteriosclerosis)

Respiratory system: Asthma, Chronic obstructive airways diseases.
Renal system: Acute and chronic renal failure.

Unit III : **10Hours**

Haematological Diseases: Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia

Endocrine system: Diabetes, thyroid diseases, disorders of sex hormones

Nervous system: Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease.

Gastrointestinal system: Peptic Ulcer

Unit IV: **8 Hours**

· Inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease.
· Disease of bones and joints: Rheumatoid arthritis, osteoporosis and gout
· Principles of cancer: classification, etiology and pathogenesis of cancer
· Diseases of bones and joints:Rheumatoid Arthritis, Osteoporosis,Gout
· Principles of Cancer: Classification, etiology and pathogenesis of Cancer

Unit V: **7 Hours**

Infectious diseases: Meningitis,Typhoid, Leprosy, Tuberculosis Urinary tract infections
Sexually transmitted diseases:AIDS, Syphilis, Gonorrhea

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Pathologic basis of disease – Robins SL, W.B Saunders publication.
2. Pathology and therapeutics for Pharmacist: A basis for clinical pharmacy practice – Green and Harris, Chapman and Hall publication.

Web Links:

W1:https://www.pharmaguideline.com/2022/01/basic-principles-of-cell-injury-and-adoptation.html
W2:https://www.pharmaguideline.com/2022/01/cardiovascular-system.html
W3:https://www.pharmaguideline.com/2022/01/hematological-diseases.html
W4:https://www.pharmaguideline.com/2022/01/principles-of-cancer.html
W5:https://my.clevelandclinic.org/health/diseases/17724-infectious-diseases

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COMPUTER APPLICATIONS IN PHARMACY (Theory)

Subject Code: 2513PY18

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

COB1: know the various types of application of computers in pharmacy

COB2: know the various types of databases

COB3: know the various applications of databases in pharmacy

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

CO1: Illustrate the concept of number system in computers.

CO2: Describe use of web technologies such as HTML, XML, CSS, Programming languages, Web servers and pharmacy drug database.

CO3: Discuss about different types of databases, applications of computers And databases in pharmacy.

CO4: Appraise the applications of computers in pharmacy such as drug information services, pharmacokinetics, mathematical model in drug design, hospital and clinical pharmacy etc.

CO5: Explain about bioinformatics and its impact in vaccine discovery and database.

CO6: Analyses computers as data analysis in preclinical development.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course content: **30 hours**

UNIT-I **06 hours**

Number system: Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement, Two's complement method, binary multiplication, binary division.

Concept of Information Systems and Software: Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project

UNIT –II **06 hours**

Web technologies: Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products

Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database

UNIT – III **06 hours**

Application of computers in Pharmacy – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring

Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System

UNIT – IV **06 hours**

Bioinformatics: Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery

UNIT-V **06 hours**

Computers as data analysis in Preclinical development: Chromatographic data analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS)

Textbooks:

1. Computer Application in Pharmacy – William E.Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.
2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA

REFERENCES:

1. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishersand Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)
2. Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N.Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi – 110002
3. Computer Application in Pharmacy – Munishgoyal, Varunarora, Span K. Shah – PV Publications

Web Links:

W1: https://www.pharmaguideline.com/2022/01/binary-number-system-decimal-number-system.html
W2: https://www.pharmaguideline.com/2022/01/introduction-to-html-xml-css-and-programming-languages.html
W3: https://www.scribd.com/document/661291058/UNIT-III-Lecture-Notes-BP205T-Computer-Applications-in-Pharmacy-Updated-30-07-2020
W4: https://www.pharmaguideline.com/2022/01/introduction-objective-of-bioinformatics.html
W5: https://www.pharmaguideline.com/2022/01/computers-as-data-analysis-in-preclinical-development.html

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0	0	2	1

COMPUTER APPLICATIONS IN PHARMACY (Practical)

Subject code: 2513PY23

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

COB1: know how to use MS Office

COB2: know the various types of databases

COB3: know the various applications of databases in pharmacy

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

CO1: Demonstrate and make use of MS Word suite and concepts of information systems and software.

CO2: Summarize the report and to design a web page Using HTML and drug information system.

CO3: Describe the adverse effects using online tools and paradigms of program languages and be exposed to at least one database (SQL)

CO4: Create and make use of MS Access suite and bioinformatics

CO5: Determine the knowledge of computers in pharmacy, web and XML pages

CO6: Design and make use of MS Excel and Power point suite and preclinical development.

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
CO2	3		3	2							3
CO3	3		3	2							3
CO4	3		3	2							3
CO5	3		3	2							3
CO6	3		3	2							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	3	2
CO6	3	2

Course Content: **2 Hours/Week**

List of Experiments:

Expt. No	Title of the Experiment	CO
1	Design a questionnaire using a word processing package to gather information about a particular disease.	CO1
2.	Create a HTML webpage to show personal information.	CO2
3.	Retrieve the information of a drug and its adverse effects using online tools	CO3
4.	Creating mailing labels Using Label Wizard, generating label in MS WORD	CO4
5.	Create a database in MS Access to store the patient information with the required fields Using access	CO4
6.	Design a form in MS Access to view, add, delete and modify the patient record in the database	CO4
7.	Generating report and printing the report from patient database	CO4
8.	Creating invoice table using – MS Access	CO4
9.	Drug information storage and retrieval using MS Access	CO4
10.	Creating and working with queries in MS Access	CO4
11.	Exporting Tables, Queries, Forms and Reports to webpages	CO5
12.	Exporting Tables, Queries, Forms and Reports to XML pages	CO5
13.	Creating a Students Mark list	CO6
14.	Creating a power point presentation	CO6

Text Books:

1. Computer Application in Pharmacy – William E.Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.
2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA

REFERENCES:

1. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishersand Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)
2. Computer Application in Pharmacy – Munishgoyal, Varunarora, Span K. Shah – PV Publications

Web Links:

W1: https://pharmacyinfoline.com/design-questionnaire-word-disease/
W2:https://pharmacyinfoline.com/create-html-web-page-personal-information/
W3:https://pharmacyinfoline.com/database-ms-access-patient-information/
W4:https://pharmacyinfoline.com/creating-invoice-ms-access/
W5:https://pharmacyinfoline.com/exporting-tables-queries-reports-web-pages/

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3	0	0	3

Environmental science (Theory)

Subject Code: 2513PY19

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

COB1: Create the awareness about environmental problems among learners.

COB2: Impart basic knowledge about the environment and its allied problems.

COB3: Develop an attitude of concern for the environment.

COB4: Motivate learner to participate in environment protection and environment improvement.

COB5: Acquire skills to help the concerned individuals in identifying and solving environmental problems.

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

CO1: Analyze multidisciplinary nature of environmental studies.

CO2: Understand importance of various natural resources like forest, water, food.

CO3: Enumerate the concept, structure and functions of an ecosystem.

CO4: Illustrate various types of ecosystems.

CO5: State about environmental pollutions.

CO6: Explain about pollution, control and preventive measures for pollutions.

Mapping of Course Outcomes with Program Outcomes:

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

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

Course content: **30hours**

UNIT-I **10 Hours**

The Multidisciplinary nature of environmental studies Natural Resources Renewable and non-renewable resources: Natural resources and associated problems a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

UNIT-II **10 Hours**

Ecosystems

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT- III **10 Hours**

Environmental Pollution: Air pollution; Water pollution; Soil pollution.

Text books:

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore.

2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.

References

1. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India,

2. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p

Web links:

W1.Air Pollution Facts, Causes and the Effects of Pollutants in the Air

W2.(PDF) Soil pollution: Causes, effects and control

W3.Ecosystem | Definition, Components, Examples, Structure, & Facts Britannica

W4.(PDF) Multidisciplinary Approach to Environmental Problems and sustainability

SEMESTER III

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3	1	0	4

PHARMACEUTICAL ORGANIC CHEMISTRY-II (Theory)

SUBJECT CODE: 2513PY24

Course Objectives: Upon completion of the course the student shall be able to
COB1: Write the structure, name and the type of isomerism ofthe organic compound
COB2: Write the reaction, name the reaction and orientation of reactions
COB3: Account for reactivity/stabilityof compounds,
COB4: Prepareorganic compounds

Course Outcomes: At the end of the course, the student will be able to:
CO1: Explain the structure, aromaticity, and reactions of benzene and its derivatives.
CO2: Describe the properties, acidity, and uses of phenols and related compounds.
CO3: Justify Aromatic amines, Aromatic acids
CO4: Analyze chemical reactions and evaluate analytical constants of oils and fats.
CO5: Polynuclear hydrocarbons: Synthesis, reactions Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane
CO6: Assess the stability and reactivity of cycloalkanes using strain theories.

Mapping of Course Outcomes with Program Outcomes:

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

Course Content **45 Hours**

UNIT I **10 Hours**

Benzene and its derivatives

A. Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule

B. Reactions of benzene - nitration, sulphonation, halogenation- reactivity, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation.
C. Substituents, effect of substituent's on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction
D. Structure and uses of DDT, Saccharin, BHC and Chloramine

UNIT II **10 Hours**

- **Phenols*** - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols
- **Aromatic Amines* -** Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts
- **Aromatic Acids*** –Acidity, effect of substituents on acidity and important reactions of benzoic acid.

UNIT III **10 Hours**

Fats and Oils

a. Fatty acids reactions.
b. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.
c. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.

UNIT IV **08 Hours**

Polynuclear hydrocarbons:

a. Synthesis, reactions
b. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives

UNIT V **07 Hours**

Cyclo alkanes*

Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only

Text Books:

1. A text book of organic chemistry – Arun Bahl, B.S. Bahl.
2. Organic Chemistry by Morrison and Boyd

Reference Books:

1. Bentley and Driver-Text book of Pharmaceutical chemistry
2. I.L.Finer- Organic chemistry, the fundamentals of chemistry Reference books
3. Organic chemistry – J.M.Cram and D.J.Cram

Web Links:

W1:https://drive.google.com/file/d/1vIDHSmQlj9npKHY-60w_Lrp_90gcriMK/view

W2:https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(Wade)_Complete_and_Semesters_I_and_II/Map%3A_Organic_Chemistry_(Wade)/17%3A_Aromatic_Compounds/17.02%3A_The_Structure_and_Properties_of_Benzene_and_its_Derivatives

W3:https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(Smith)/15%3A_Benzene_and_Aromatic_Compounds/15.07%3A_The_Criteria_for_Aromaticity_-_Huckels_Rule

W4: https://www.vedantu.com/chemistry/friedel-crafts-reaction-alkylation-acylation

W5: https://byjus.com/chemistry/test-for-phenolic-group/

L	T	P	C
0	0	4	2

PHARMACEUTICAL ORGANIC CHEMISTRY -II(Practical)

Subject Code: 2513PY28
Course Objectives: Upon completion of the course, the student shall be able to
COB1: Write the structure, name and the type of isomerism of the organic compound
COB2: Write the reaction, name the reaction and orientation of reactions
COB3: Account for reactivity/stability of compounds,
COB4: Prepare organic compounds

Course Outcomes: At the end of the course, student will be able to
CO1: Demonstrate the laboratory techniques.
CO2: Describe the Purification techniques
CO3: Determination of acid value, Saponification value, Iodine value
CO4: Preparation of acetanilide, 2,4,6-tri bromoaniline, m-dinitrobenzene
CO5: Preparation of various organic compounds by oxidation, diazotization and coupling reactions
CO6: Apply the principles of named reactions in synthesis of organic 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					3	3	3
CO2	3		2	2					3	2	2
CO3	3		2	2					2	2	2
CO4	3		3	2					2	3	2
CO5	3		3	3					3	2	2
CO6	3		2	3					2	3	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **4 Hours/week**

List of Experiments:

Expt. No	Title	CO
1.	Introduction to Basic laboratory techniques	CO1
2.	Steam Distillation & Recrystallization	CO2
3.	Determination of Acid value	CO3
4.	Determination of Saponification value	CO3
5.	Determination of Iodine value	CO3
6.	Preparation of Acetanilide	CO3
7.	Preparation of 2,4,6-tri bromoaniline	CO4
8.	Preparation of m-dinitrobenzene	CO4
9.	Preparation of Benzoic acid from Benzyl chloride by oxidation reaction.	CO5
10.	Preparation of Benzoic acid from Ethyl benzoate	CO5
11.	Preparation Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions.	CO5
12.	Preparation of Benzil from Benzoin by oxidation reaction.	CO5
13.	Preparation of Dibenzal acetone from Benzaldehyde by Claison Schmidt reaction	CO6
14.	Preparation of Cinnammic acid from Benzaldehyde by Perkin reaction	CO6
15.	Preparation of P-Iodo benzoic acid from P-amino benzoic acid	CO6

Text Books:

1. Practical Organic Chemistry by Mann and Saunders.
2. Vogel's text book of Practical Organic Chemistry

Reference Books:

1. Advanced Practical organic chemistry by N.K.Vishnoi.
2. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.
3. Organic Chemistry by Morrison and Boyd

Web Links:

W1:https://compress-pdf.bcad.info/#google_vignette
W2:https://www.pharmaguideline.com/2007/01/significance-and-principle-involved-in-determination-of-acid-value.html#google_vignette
W3:https://allbachelor.com/2024/04/02/to-prepare-phenyl-azo-%CE%B2-naphthol-from-aniline/#:~:text=Phenyl%20azo-%CE%B2-Naphthol%20is%20a%20common%20example%20of%20azodye.,NaNO%202%20%2B%20HCL%20%E2%80%94%E2%80%94%E2%80%94%E2%80%94-%3E%20HNO%203%20%2BNaCl
W4: https://www.ijarsct.co.in/Paper10747.pdf
W5: https://chemiologist.com/perkin-condensation-synthesis-of-cinnamic-acid/

L	T	P	C
3	1	0	4

PHYSICAL PHARMACEUTICS – I (THEORY)

Course Code: 2513PY25

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

COB1: The course aims to provide foundational understanding of key principles and concepts in physical pharmacy.

COB2: Will be able to comprehend and analyse pharmaceutical systems, laying the groundwork for further studies in pharmaceutics and pharmaceutical sciences.

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

CO1: Explain the Definitions, solubility terms, principle of diffusion, Types of solutions.

CO2: Describe the States of matter and properties of matter, Physico chemical properties of drug molecules.

CO3: Tell about the Surface and interfacial phenomenon.

CO4: Classify Complexation and Recall Complexation and protein binding.

CO5: Assess the methods of analysis.

CO6: Relate pH, buffers and isotonic solutions with the pharmaceutical applications.

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	3	
CO2	2	
CO3	2	
CO4	2	
CO5	3	
CO6	3	

CourseContent **45 Hours**

UNIT-I **10 Hours**

Solubility of drugs: Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications

UNIT-II **10 Hours**

States of Matter and properties of matter: State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols– inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid- crystalline, amorphous & polymorphism.

Physicochemical properties of drug molecules: Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications

UNIT-III **10 Hours**

Surface and interfacial phenomenon: Liquid interface, surface & interfacial tensions,surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface.

UNIT-IV **08 Hours**

Complexation and protein binding: Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.

UNIT-V **07 Hours**

pH, buffers and Isotonic solutions: Sorensen*f*s pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.

Text Books:

1. Martins Physical Pharmacy and Pharmaceutical Sciences by Patrick j. Sinko.
2. Bentlys textbook of Pharmaceutics by E.A.Rawlins

Reference Books:

1. Experimental Pharmaceutics by Eugene, Parott.
2. Tutorial Pharmacy by Cooper and Gunn.
3. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.

Web Links:

W1: https://magadhuniversity.ac.in/download/econtent/pdf/Gas%20in%20liquid.pdf
W2: https://www.pharmaguideline.com/2021/10/latent-heats-vapor-pressure-and-sublimation-critical-point.html
W3: https://www.chem.uzh.ch/dam/jcr:07de8ca0-618d-40f8-85ce-3403c8df22a3/Dipole_Moment_HS16.pdf
W4: https://www.atascientific.com.au/wp-content/uploads/2017/02/surface-and-interfacial-tension-what-is-it-and-how-to-measure-it.pdf
W5: https://www.magadhuniversity.ac.in/download/econtent/pdf/Distribution%20law_Pharm%20Eng%20I_2nd%20Yr.pdf
W6: https://snscourseware.org/snscphs/files/1621259206.pdf

L	T	P	C
0	0	4	2

PHYSICAL PHARMACEUTICS-I (PRACTICAL)

Course Code: 2513PY29

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

COB1: The course aims to provide foundational understanding of key principles and concepts in physical pharmacy.

COB2: Will be able to comprehend and analyse pharmaceutical systems, laying the groundwork for further studies in pharmaceutics and pharmaceutical sciences.

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

CO1: Calculate the solubility of drugs at room temperature & pKa value by using Half Neutralization.

CO2: Determination of Partition Coefficient, Surface Tension of Given Liquid.

CO3: Determination of Critical Micellar Concentration of a surfactant, HLB number of surfactants.

CO4: Determine the % composition of sodium chloride in a solution.

CO5: Determination of adsorption by Freundlich and Langmuir's constant using activated charcoal.

CO6: Determination of Stability Constant and Donor Acceptor Ratio of PABA-Caffeine Complex by Solubility Method.

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	3	
CO2	3	
CO3	2	
CO4	3	
CO5	3	
CO6	3	

Course Content: **4 Hours/Week**

List of Experiments:

Expt. No	Title	CO
1.	Determination of solubility of the drug at Room Temperature	CO1
2.	Determination of pKa Value by half Neutralization Method	CO1
3.	Determination of Partition Coefficient of Benzoic Acid in Benzene and Water	CO2
4.	Determination of Surface Tension of Given Liquid by using Drop Count Method	CO2
5.	Determination of Surface Tension of given liquid by using drop weight method	CO2
6.	Determination of percentage composition of Nacl in a solution using phenol water system by CST method	CO4
7.	Determination of Critical Micellar Concentration of a surfactant	CO3
8.	Determination of HLB number of surfactants by saponification method	CO3
9.	Determination of Freundlich and Langmuir's constant using the activated charcoal	CO5
10.	Determination of Stability Constant and Donor Acceptor Ratio of PABA-Caffeine Complex by Solubility Method	CO6

TEXT BOOKS:

1. Martins Physical Pharmacy and Pharmaceutical Sciences by Patrick j. Sinko.
2. Bentlys textbook of Pharmaceutics by E.A.Rawlins
3. Aultons Pharmaceutics by Michael.E.Aulton, Kevein M.G.Tayler.

REFERENCE BOOKS:

1. Experimental Pharmaceutics by Eugene, Parott.
2. Tutorial Pharmacy by Cooper and Gunn.
3. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
4. Physical Pharmaceutics by C.V.S. Subramanyam

WEB LINKS:

W1: https://magadhuniversity.ac.in/download/econtent/pdf/Gas%20in%20liquid.pdf
W2:https://www.pharmaguideline.com/2021/10/latent-heats-vapor-pressure-and-sublimation-critical-point.html
W3:https://www.chem.uzh.ch/dam/jcr:07de8ca0-618d-40f8-85ce-3403c8df22a3/Dipole_Moment_HS16.pdf
W4:https://www.atascientific.com.au/wp-content/uploads/2017/02/surface-and-interfacial-tension-what-is-it-and-how-to-measure-it.pdf
W5:https://www.magadhuniversity.ac.in/download/econtent/pdf/Distribution%20law_Pharm%20Eng%20I_2nd%20Yr.pdf

L	T	P	C
3	1	0	4

PHARMACEUTICAL MICROBIOLOGY (Theory)

Course Code: 2513PY26

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

COB1: Understand methods of identification, cultivation, and preservation of various microorganisms.

COB2: Comprehend sterilization methods and their implementation in pharmaceutical processing and industry.

COB3: Learn sterility testing and disinfection protocols for pharmaceutical products.

COB4: Apply microbiological assays and standardization techniques for pharmaceuticals.

COB5: Understand microbial spoilage and preservation of pharmaceutical products.

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

CO1: Explain microbiology fundamentals including morphology, classification, and microscopy of microorganisms.

CO2: Identify microorganisms by staining and evaluate sterilization methods and indicators.

CO3: Describe morphology and cultivation of fungi/viruses and apply sterilization testing as per IP, BP, and USP.

CO4: Design aseptic areas and apply microbiological assays for pharmaceutical standardization.

CO5: Assess microbial spoilage and contamination sources in pharmaceutical products.

CO6: Evaluate preservation techniques and microbial stability of pharmaceutical formulations.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO10	PO11
CO1	3	1	2	2	1	1	2	1	2	2	2
CO2	3	2	3	3	1	2	3	1	2	3	2
CO3	3	2	3	3	1	2	3	1	3	3	3
CO4	3	2	3	3	1	2	3	2	3	3	3
CO5	3	2	2	2	1	2	2	1	2	3	2
CO6	3	2	2	3	1	2	3	1	3	2	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **45 Hours**

UNIT-I **10 Hours**

Introduction, history of microbiology, its branches, scope and its importance. Introduction to Prokaryotes and Eukaryotes Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy**.**

UNIT-II **10 Hours**

Identification of bacteria using staining techniques (simple, Gram's & Acid fast staining) and biochemical tests (IMViC).

Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization.

Evaluation of the efficiency of sterilization methods.

Equipments employed in large scale sterilization.

Sterility indicators.

UNIT-III **10Hours**

Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses.

Classification and mode of action of disinfectants Factors influencing disinfection, antiseptics and their evaluation.

For bacteriostatic and bactericidal actions: Evaluation of bactericidal & Bacteriostatic activity.

Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.

UNIT- IV **08 Hours**

Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification.

Principles and methods of different microbiological assay.

Methods for standardization of antibiotics, vitamins and amino acids.

Assessment of a new antibiotic.

UNIT-V **07 Hours**

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage.

Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.

Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures. Applications of cells cultures in Pharmaceutical industry and research.

Text Books:

1. W.B. Hugo and A.D. Russell, *Pharmaceutical Microbiology*, Blackwell Scientific.
2. Pelczar, Chan, Krieg, *Microbiology*, Tata McGraw Hill.
3. Prescott & Dunn, *Industrial Microbiology*, CBS Publishers.

Reference Books:

1. Ananthanarayan and Paniker, *Textbook of Microbiology*, Orient Longman.
2. N.K. Jain, *Pharmaceutical Microbiology*, Vallabh Prakashan.
3. Edward Alcamo, *Fundamentals of Microbiology*, Jones & Bartlett Learning.

Web Links:

W1: https://www.pharmaguideline.com/2019/08/sterilization-methods-in-pharma.html
W2: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4957381/
W3: https://www.biologydiscussion.com/microbiology/
W4: https://www.pharmatutor.org/articles/microbiological-assay-and-standardization-techniques
W5: https://www.microbiologyinfo.com/

L	T	P	C
0	0	4	2

PHARMACEUTICAL MICROBIOLOGY (Practical)

Course Code: 2513PY30

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

COB1: Perform fundamental microbiological techniques safely and accurately.

COB2: Conduct staining, culturing, and identification of microorganisms.

COB3: Evaluate sterilization methods and analyse their efficacy.

COB4: Perform microbial assay and assess microbial contamination.

COB5: Develop competency in maintaining sterile environments and interpreting microbiological results.

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

CO1: Practice aseptic techniques and handle microbiological equipment.

CO2: Demonstrate various staining techniques and microscopic examination.

CO3: Perform cultivation and enumeration of microorganisms.

CO4: Evaluate sterilization techniques and carry out sterility testing.

CO5: Conduct microbial assays and interpret microbial growth patterns.

CO6: Determine bacterial motility by Hanging drop method and quality of water by bacteriological analysis

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content: **4 Hours/Week**

List of Experiments:

Expt. No	Title	CO
1.	Introduction and practice of aseptic techniques.	**CO1**
2.	Sterilization of glassware, media preparation and sterilization.	**CO2**
3.	Subculturing of bacteria and fungi.	**CO3**
4.	Isolation of pure cultures using streak plate, pour plate and spread plate techniques.	**CO3**
5.	Staining methods: Simple staining, Gram's staining, and Acid-fast staining.	**CO4**
6.	Motility testing of bacteria (hanging drop method).	**CO6**
7.	Preparation of growth curves of microorganisms and enumeration by turbidimetry.	**CO3**
8.	Microbial sensitivity testing using disc diffusion method.	**CO5**
9.	Test for microbiological assay of antibiotics (cup plate method).	**CO5**
10.	Sterility testing of sterile pharmaceutical products.	**CO4**
11.	Demonstration of microbial contamination in pharmaceutical environments.	**CO5**
12.	Evaluation of disinfectants (phenol coefficient method).	**CO4**
13.	Microscopic observation of fungi and bacterial spores.	**CO5**
14.	Cultivation of anaerobic bacteria.	**CO5**

Text Books:

1. W.B. Hugo and A.D. Russell, Pharmaceutical Microbiology, Blackwell Scientific.
2. Pelczar, Chan, Krieg, Microbiology, Tata McGraw Hill.
3. Prescott & Dunn, Industrial Microbiology, CBS Publishers.

Reference Books:

1. Ananthanarayan and Paniker, Textbook of Microbiology, Orient Longman.
2. N.K. Jain, Pharmaceutical Microbiology, Vallabh Prakashan.
3. Edward Alcamo, Fundamentals of Microbiology, Jones & Bartlett Learning.

Web Links:

W1: https://www.pharmaguideline.com/2019/08/sterilization-methods-in-pharma.html
W2: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4957381/
W3: https://www.biologydiscussion.com/microbiology/
W4: https://www.pharmatutor.org/articles/microbiological-assay-and-standardization-techniques
W5: https://www.microbiologyinfo.com/

L	T	P	C
3	1	0	4

PHARMACEUTICAL ENGINEERING (Theory)

Subject Code: 2513PY27

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

COB1: Understand the various unit operations employed in the pharmaceutical industry**.**

COB2: Explain the principles and equipment used in size reduction, separation, and mixing.

COB3: Demonstrate knowledge of heat transfer processes and related equipment like evaporators and distillation units.

COB4: Analyze processes like drying, filtration, and centrifugation, including their applications and operational parameters.

COB5: Comprehend the importance of corrosion control, material handling, and the selection of plant construction materials in pharmaceutical manufacturing.

Course Outcomes (COs):

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

CO1: Describe fluid flow properties, measurement devices, and energy considerations in pharmaceutical operations.

CO2: Explain size reduction, size separation, and mixing processes along with relevant equipment.

CO3: Apply knowledge of heat transfer and evaporation principles in industrial pharmaceutical processes.

CO4: Illustrate the drying, filtration, and centrifugation processes used in drug manufacturing.

CO5: Identify suitable materials for pharmaceutical plant construction and suggest corrosion prevention techniques.

CO6: Discuss material handling systems applicable to pharmaceutical industries.

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	PO 10	PO 11
CO 1	3	2	3	2	1			1			2
CO 2	3	2	3	2	1			1			2
CO 3	3	2	3	3	1			1			2
CO 4	3	2	3	3	1			1			2
CO 5	3	1	2	2	1		1	1	2	2	2
CO 6	3	2	3	3	2	2	1	1	2	1	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	2
CO6	3	2

Course content: **45 Hours**

UNIT-I **10 Hours**

- Flow of fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer.
- Size Reduction: Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.
- Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

UNIT-II **10 Hours**

- Heat Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law,
- Heat transfer by conduction, convection & radiation. Heat interchangers heat exchangers.
- Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator.
- Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation.

UNIT- III **08 Hours**

- Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.
- Mixing: Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier.

UNIT-IV **08 Hours**

- Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter &Cartridge filter, membrane filters and Seidtz filter.
- Centrifugation: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

UNIT- V **07 Hours**

- Materials of pharmaceutical plant construction, Corrosion and its prevention: Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

Text Books:

1. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition.
2. Theory and practice of industrial pharmacy by Lachmann., Latest edition.

References:

1. Pharmaceutical Engineering: Principles and Practices, Author: C.V.S. Subrahmanyam, Publisher: Vallabh Prakashan.
2. The Theory and Practice of Industrial Pharmacy, Authors: Lachman, Lieberman, Kanig Publisher: Lea & Febiger
3. Introduction to Chemical Engineering, Authors: Badger W.L. and Banchero J.T. Publisher: McGraw-Hill Education

Web Links:

W1. https://pharmaguideline.com/2018/06/size-reduction-equipment.html
W2. https://pharmacygyan.com/distillation-methods-in-pharmaceutical-industry/
W3. https://www.pharmaguideline.com/2018/06/size-reduction-equipment.html
W4. https://www.slideshare.net/sidharthjain163/evaporation-pharmaceutical-engineering
W5. https://pharmaguideline.com/2019/11/filtration-equipment.html

L	T	P	C
0	0	4	2

Pharmaceutical Engineering (Practical)

Subject Code: 2513PY31

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

COB1: Understand and determine the heat transfer properties and mechanisms through various experiments.

COB2: Demonstrate practical skills in unit operations like distillation, evaporation, drying, and filtration.

COB3: Evaluate pharmaceutical process equipment such as ball mills, dryers, and tablet machines.

COB4: Analyze and interpret experimental data for processes like crystallization, size reduction, and mixing.

COB5: Describe construction, working, and application of various pharmaceutical machinery used in the industry.

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

CO1: Determine thermal properties like radiation constant, heat transfer coefficient, and humidity in pharmaceutical operations.

CO2: Apply practical knowledge to distillation, drying curves, moisture content determination, and evaporation processes.

CO3: Analyze and evaluate size reduction and size separation processes using mills and sieves.

CO4: Illustrate the working and efficiency of various pharmaceutical processing equipment.

CO5: Demonstrate filtration, crystallization, and material mixing processes and factors affecting these unit operations.

CO6: Calculate process efficiency parameters such as uniformity index, moisture content, and particle size distribution in pharmaceutical preparations.

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	2	1	1	-	-	1	2	2
CO 2	3	2	3	2	2	1	1	-	2	2	2
CO 3	3	3	3	3	2	2	1	-	2	2	2
CO 4	3	2	3	3	2	2	1	-	2	2	2
CO 5	3	2	3	3	2	2	1	1	2	2	2
CO 6	3	2	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	2
CO3	3	3
CO4	3	3
CO5	3	3
CO6	3	3

Course content: **4 Hours/week**

Expt. No	Title	CO
1.	Determinationof radiation constant of brass, iron, unpainted and painted glass	**CO1**
2.	Steam distillation – To calculate the efficiency of steam distillation.	**CO1**
3.	To determine the overall heat transfer coefficient by heat exchanger.	**CO2**
4.	Construction of drying curves (for calcium carbonate and starch).	**CO2**
5.	Determination of moisture content and loss on drying.	**CO3**
6.	Determination of humidity of air – i) Fromwet and drybulb temperatures –use of Dew point method.	**CO3**

Text Books:

1. Pharmaceutical Engineering: Principles and Practices Author: C.V.S. Subrahmanyam

   Publisher: Vallabh Prakashan.

2. The Theory and Practice of Industrial Pharmacy, Authors: Leon Lachman, Herbert A. Lieberman, Joseph L. Kanig, Publisher: Lea & Febiger.

REFERENCES:

1. Introductionto chemicalengineering – Walter L Badger & Julius Banchero, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson-Latest edition.

Web links:

W1 https://pharmacygyan.com/heat-transfer-drying-evaporation-and-distillation-in pharmaceutical-engineering/

W2 https://labmonk.com/steam-distillation-principle-procedure-application/

W3 https://www.engineeringtoolbox.com/humidity-measurement-d_561.html

W4 https://pharmaguideline.com/2020/01/pharmaceutical-machinery.html

W5 https://pharmaguideline.com/2018/06/size-reduction-equipment.html

SEMESTER IV

L	T	P	C
3	1	0	4

PHARMACEUTICAL ORGANIC CHEMISTRY- III (Theory)

Subject Code: 2513PY32

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

COB1: Understand the methods of preparation and properties of organic compounds

COB2: Explain the stereo chemical aspects of organic compounds and stereo chemical reactions

COB3: Know the medicinal uses and other applications of organic compounds

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

CO1: Explain the principles of optical isomerism, enantiomerism, diastereoisomerism, meso compounds, chirality, and apply DL and RS systems for stereochemical representation.

CO2: Describe the reactions of chiral molecules and outline various methods of asymmetric synthesis and resolution of racemic mixtures.

CO3: Illustrate geometrical and conformational isomerism in organic compounds and apply nomenclature systems like E/Z, Cis/Trans, Syn/Anti.

CO4: Classify heterocyclic compounds and outline the synthesis, reactions, and medicinal uses of pyrrole, furan, thiophene, and their derivatives.

CO5: Explain the chemistry and pharmacological relevance of nitrogen-containing heterocycles such as pyridine, quinoline, imidazole, and purine.

CO6: Outline key organic reaction mechanisms including reductions, oxidations, rearrangements, and condensations and apply them in synthetic transformations.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **45 Hours**

Note: To emphasize on definition, types, mechanisms, examples, uses/applications

UNIT-I **10 Hours**

Stereo isomerism Optical isomerism – Optical activity, enantiomerism, diastereoisomerism, meso compounds Elements of symmetry, chiral and achiral molecules DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers Reactions of chiral molecules Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute

UNIT-II **10 Hours**

Geometrical isomerism Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems) Methods of determination of configuration of geometrical isomers. Conformational isomerism in Ethane, n-Butane and Cyclohexane. Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity. Stereospecific and stereo selective reactions.

UNIT-III **10 Hours**

Heterocyclic compounds: Nomenclature and classification Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrrole, Furan, and Thiophene Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene.

UNIT-IV **08 Hours**

Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrazole, Imidazole, Oxazole and Thiazole. Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their Derivatives.

UNIT-V **07 Hours**

Reactions of synthetic importance Metal hydride reduction (NaBH4 and LiAlH4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation.

Text Books:

1. Organic chemistry by I.L. Finar, Volume-I & II.
2. A text book of organic chemistry – Arun Bahl, B.S. Bahl.
3. Organic Chemistry by Morrison and Boyd

Reference Books:

1. Bentley and Driver-Text book of Pharmaceutical chemistry
2. Organic chemistry – J.M.Cram and D.J.Cram

Web Links:

W1 https://www.aakash.ac.in/important-concepts/chemistry/heterocyclic-compounds

W2 https://chem.libretexts.org/Courses/Purdue/Purdue_Chem_26100%3A_Organic_Chemistry_I_(Wenthold)/Chapter_03%3A_Structure_of_Alkanes/3.4.%09Structure_and_Conformations_of_Alkanes/3.4.2._Conformations_of_Ethane

W3 https://www.researchgate.net/publication/354061709_Synthesis_reactions_and_applications_of_pyrimidine_derivatives/link/61229bcf232f955865a2e5d5/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19

W4 https://www.researchgate.net/publication/329059499_UNITV_Reactions_of_Synthetic_Importance_BP401T_PHARMACEUTICAL_ORGANIC_CHEMISTRYIII_Metal_hydride_reduction_NaBH_4_and_LiAlH_4?enrichId=rgreq6044c0ce611c09ba47c664693702e42cXXX&enrichSource=Y292ZXJQYWdlOzMyOTA1OTQ5OTtBUzo2OTQ5NzYwNDAxNTcxOTRAMTU0MjcwNjYwODU2MA%3D%3D&el=1_x_2&_esc=publicationCoverPdf

W5 https://books.google.co.in/books/about/A_Textbook_of_Organic_Chemistry.html?id=0qAbEAAAQBAJ&redir_esc=y

L	T	P	C
3	1	0	4

Pharmaceutical Medicinal Chemistry-I

Course code: 2513PY33

Course objectives: 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 (SAR) of different class of drugs

COB4: know the chemical synthesis of some important drugs

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

CO1: Describe the history of profession of pharmacy, fundamental knowledge on the structure, chemistry and therapeutic value of drugs.
CO2: Compose the structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs.
CO3: Classify the chemistry of drugs with respect to their pharmacological activity metabolic pathways, adverse effect and therapeutic value of drugs
CO4: Elaborate the Structural Activity Relationship (SAR) of different class of drugs
CO5: Characterise Phenothiazine's and its SAR
CO6: Justify the techniques involved in the synthesis of drugs, purification methods applied.

Mapping of course outcomes with program specific outcomes

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

Course Content **45 Hours**

UNIT- I **10 hours**

Introduction to Medicinal Chemistry

History and development of medicinal chemistry physicochemical properties in relation to biological action

Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.

Drug metabolism

Drug metabolism principles- Phase I and Phase II.

Factors affecting drug metabolism including stereo chemical aspects.

UNIT- II **10 hours**

Drugs acting on Autonomic Nervous System Adrenergic Neurotransmitters:

Biosynthesis and catabolism of catecholamine.

Adrenergic receptors (Alpha & Beta) and their distribution.

Sympathomimetic agents: SAR of Sympathomimetic agents

Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine, Dopamine,

Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline.

Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine.

Agents with mixed mechanism: Ephedrine, Metaraminol.

Adrenergic Antagonists:

Alpha adrenergic blockers: Tolazoline, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide.

Beta adrenergic blockers: SAR of beta blockers, Propranolol, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.

UNIT-III **08hours**

Cholinergic neurotransmitters:

Biosynthesis and catabolism of acetylcholine.

Cholinergic receptors (Muscarinic & Nicotinic) and their distribution.

Parasympathomimetic agents: SAR of Parasympathomimetic agents

Direct acting agents: Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine.

Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible): Physostigmine,

Neostigmine, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride,

Ambenonium chloride, Isofluorphate, Echothiophate iodide, Parathione, Malathion.

Cholinesterase reactivator: Pralidoxime chloride.

Cholinergic Blocking agents: SAR of cholinolytic agents

Solanaceous alkaloids and analogues: Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide.

Synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

UNIT- IV **10 hours**

Drugs acting on Central Nervous System

Sedatives and Hypnotics:

Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem

Barbiturtes: SAR of barbiturates, Barbital, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital

Miscelleneous:

Amides & imides: Glutethmide.

Alcohol & their carbamate derivatives: Meprobomate, Ethchlorvynol. Aldehyde & their derivatives:

A. Antipsychotics

Phenothiazeines: SAR of Phenothiazeines - Promazine hydrochloride, Chlorpromazine hydrochloride, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.

Ring Analogues of Phenothiazeines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine.

Fluro buterophenones: Haloperidol, Droperidol, Risperidone.

Beta amino ketones: Molindone hydrochloride.

Benzamides: Sulpieride.

Anticonvulsants: SAR of Anticonvulsants**,** mechanism of anticonvulsant action

Barbiturates: Phenobarbitone, Methabarbital. **Hydantoins:**

Phenytoin, Mephenytoin, Ethotoin **Oxazolidine diones:**

Trimethadione, Paramethadione **Succinimides:**

Phensuximide, Methsuximide, Ethosuximide **Urea and monoacylureas**: Phenacemide, Carbamazepine **Benzodiazepines**: Clonazepam

Miscellaneous: Primidone, Valproic acid , Gabapentin, Felbamate

UNIT – V **07 hours**

Drugs acting on Central Nervous System

General anesthetics:

Inhalation anesthetics: Halothane, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.

Ultra short acting barbitutrates: Methohexital sodium, Thiamylal sodium, Thiopental sodium.

Dissociative anesthetics: Ketamine hydrochloride.

Narcotic and non-narcotic analgesics

Morphine and related drugs: SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate, Methadone hydrochloride, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate.

Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride.

Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.

Text Books:

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.

Reference Books:

1. Burger's Medicinal Chemistry, Vol I to IV.
2. Introduction to principles of drug design- Smith and Williams.
3. Remington's Pharmaceutical Sciences.

Web Links:

W1: https://onlinecourses.nptel.ac.in/noc20_cy16/preview
W2: https://lms.innovesen.co.in/

W3: https://www.micromedexsolutions.com/micromedex2/librarian

W4: https://www.my-mooc.com/en/mooc/drug-discovery-medicinal-chemistry/

W5: https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=WR+tSjp4YS3g7BIFEffOcw==

L	T	P	C
0	0	4	2

Pharmaceutical Medicinal Chemistry-I

Course code: 2513PY37

Course objectives: 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 (SAR) of different class of drugs

COB4: write the chemical synthesis of some drugs

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

CO1: Understand the chemistry of drugs its synthesis methods

CO2: Determination of Partition Coefficient of drugs in a practical way

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

CO4: Preparation and characterisation of various medicinal molecules

CO5: Determination of percentage purity of medicinal molecules through performing assay

CO6: Characterisation of medicinal molecules by using chemdraw software tools.

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		3	1	3
CO2	3			3		1	1	1		1	3
CO3	3			3	1		3			1	3
CO4	3			3			1				3
CO5	3	1		3				3	2	2	3
CO6	3			3		1	1	1			3

Mapping of Course Outcomes with Program-Specific Outcomes:

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

Course Content **4 Hours/week**

List of Experiments:

Expt. No	Title	CO
1.	Preparation of 1, 3-Pyrazole,	CO1
2.	Preparation 1,3-oxazole,	CO1
3.	Preparation Benzimidazole,	CO1
4.	Preparation Benztriazole,	CO1
5.	Preparation 2,3- diphenyl quinoxaline,	CO1
6.	Preparation Benzocaine,	CO1
7.	Preparation Phenytoin,	CO1
8.	Preparation Phenothiazine,	CO1
9.	Preparation Barbiturate.	CO1
10.	Determine the Percentage purity of Chlorpromazine,	CO2
11.	Determine the Percentage purity of Phenobarbitone,	CO2
12.	Determine the Percentage purity of Atropine,	CO2
13.	Determine the Percentage purity of Ibuprofen,	CO2
14.	Determine the Percentage purity of Aspirin,	CO2
15.	Determine the Percentage purity of Furosemide.	CO2
16.	Determination of partition co-efficient of medicinal molecules.	CO3

Text Books:

1. Text book of practical organic chemistry- A.I.Vogel
2. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5

Reference Books:

1. Indian Pharmacopoeia.
2. Remington's Pharmaceutical Sciences. 6. Martindale's extra pharmacopoeia.
3. Remington's Pharmaceutical Sciences

Web Links:

W1 https://www.organic-chemistry.org/synthesis/heterocycles/pyrazoles.shtm
W2 https://aces.onlinelibrary.wiley.com/doi/abs/10.1002/ajoc.201900233
W3 https://www.tutorsglobe.com/homework-help/chemistry/determination-of-percent-purity-of-substance-77691.aspx
W4 https://jpdb.nihs.go.jp/jp14e/14data/Part-I/Aspirin.pdf
W5 https://www.sciencedirect.com/topics/chemistry/partition-coefficient

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3	1	0	4

PHYSICAL PHARMACY-II (Theory)

Subject Code: 2513PY34

Course Objectives: Upon completion of this course the student will able to

COB1: Understand various physicochemical properties of drug molecules in the designing the dosage forms

COB2: Know the principles of chemical kinetics & to use them for stability testing nad determination of expiry date of formulations

COB3: Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Course Outcomes:

CO1: Define about the coarse and colloidal dispersions

CO2: Assess the rheological properties and apply them in pharmaceutical sciences.

CO3: Explain the deformation of Solids

CO4: Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

CO5: Describe about the micrometric properties of drug molecules.

CO6: Characterize the principles of chemical kinetics for stability testing

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
CO4	3		2	1		2		2			2
CO 5	3		2	1				2	3	2	2
CO 6	3		2	1				1	2		2

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content: **45 Hours**

UNIT-I **7 Hours**

Colloidal dispersions: Classification of dispersed systems & their general characteristics, size &shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptiza-tion & protective action.

UNIT-II 08 Hours

Rheology: Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, deter-mination of viscosity, capillary, falling Sphere, rotational viscometers

Deformation of solids: Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus.

UNIT-III **10 Hours**

Coarse dispersion: Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.

UNIT-IV **10 Hours**

Micromeretics: Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods,
counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.

UNIT-V **10 Hours**

Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention.

Textbooks

1. Physical Pharmacy by Alfred Martin, Sixth edition
2. Experimentalpharmaceutics by Eugene, Parott.

References

1. Tutorial pharmacy by Cooper and Gunn.
2. StocklosamJ. Pharmaceutical calculations, Lea &Febiger, Philadelphia.
3. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.

Weblinks

W1: https://www.igntu.ac.in/eContent/IGNTU-eContent-285319954865-B.Pharma-4-SabyasachiMaiti-PhysicalPharmaceutics-II-1.pdf

W2: https://igntu.ac.in/eContent/IGNTU-eContent-287925206503-B.Pharma-4-SabyasachiMaiti-PhysicalPharmaceutics-II-3.pdf

W3: https://cdn.technologynetworks.com/tn/resources/pdf/wp160620basicintrorheology.pdf

W4: https://eopcw.com/find/downloadLectureNote/985

W5: https://ijsdr.org/papers/IJSDR2308138.pdf

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0	0	4	2

PHYSICAL PHARMACY-II (Practical)

Subject Code: 2513PY38

Course Objectives: Upon completion of this course the student will able to

COB1: To understand the determination of powder properties of drug mixtures**.**

COB2: To understand the determination of liquid and dispersion characteristics.

COB3: To understand the assessment of stability for drug product.

Course Outcomes:

Course

Outcomes

Statement

CO1: Describe the various methods for determination of particle size and distribution (Understand)

CO2: Explain the determination methods for physical properties of a drug

CO3 : Characterize the viscosity by using different viscometers

CO4 : Demonstrate the effect of suspending agent on sedimentation volume

CO5: Calculate the rate constants for order of reactions.

CO6: Evaluate the accelerated stability studies

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
CO2	3	2	2	3	-	-	-	-	-	-	3
CO3	3	3	2	3	-	-	-	-	-	-	3
CO4	3	2	2	3	-	-	-	-	-	-	3
CO5	3	2	2	3	-	-	-	-	-	-	3
CO6	3	2	3	3	-	-	-	-	-	-	3

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **4 Hours / Week**

List of experiments:

Expt. No	Title	CO
1.	Determination of particle size, particle size distribution using sieving method	**CO1**
2.	Determination of particle size, particle size distribution using Microscopic method	**CO1**
3.	Determination of bulk density, true density and porosity	**CO2**
4.	Determine the angle of repose and influence of lubricant on angle of repose	**CO2**
5.	Determination of viscosity of liquid using Ostwald's viscometer	**CO3**
6.	Determination sedimentation volume with effect of different suspending agent	**CO4**
7.	Determination sedimentation volume with effect of different concentration Of single suspending agent	**CO4**
8.	Determination of viscosity of semisolid by using Brookfield viscometer	**CO3**
9.	Determination of reaction rate constant first order.	**CO5**
10.	Determination of reaction rate constant second order	**CO5**
11.	Accelerated stability studies	**CO6**

Text Books

1. Physical Pharmacy by Alfred Martin, Sixth edition
2. Experimental pharmaceutics by Eugene, Parott.

References

1. Tutorial pharmacy by Cooper and Gunn.
2. Stock losam J. Pharmaceutical calculations, Lea & Febiger, Philadelphia.
3. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.

Weblinks

1. https://onlinelibrary.wiley.com/doi/abs/10.1002/9780470027318.a1514
2. https://www.sciencedirect.com/science/article/abs/pii/S092188311400291X
3. https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/first-order-rate-constant
4. https://pharmacyinfoline.com/determination-reaction-rate-constant-second-order/
5. https://www.americanpharmaceuticalreview.com/Featured-Articles/341253-An-Introduction-to-the-Accelerated-Stability-Assessment-Program-ASAP/

L T P C

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PHARMACOLOGY-I THEORY

SUBJECT CODE: 2513PY35

COURSE OBJECTIVES: On completion of this course, the student will able to

COB1: To understand what drugs do to living organisms and how their effects can be applied to Therapeutics.

COB2: To understand the mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism, and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.

COB3: To understand the pharmacological actions of different categories of drugs

COB4: To explain the mechanism of drug action at organ system/sub-cellular/ macromolecular levels

COB5: To apply basic pharmacological knowledge in preventing and treating various diseases.

COURSE OUTCOMES

CO1 : Understand the basics of pharmacology & Pharmacokinetics

CO2 : Demonstrate the basics of Pharmacodynamics and Drug Interactions

CO3 : Illustrate the Pharmacology of Drugs acting on the Peripheral Nervous System.

CO4: Explain the Pharmacology of the drugs acting on Neurohumoral transmission related disorders

CO5: Analyse the Pharmacology of the Drugs acting on Psychopharmacological Disorders.

CO6: Describe basic concepts of drug interactions and adverse drug reactions.

Mapping of Course Outcomes with Program Outcomes:

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

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

Course Content: **45 Hours**

Unit I: General Pharmacology **8Hours**

a. Introduction to Pharmacology – Definition, history, scope of pharmacology.
b. Sources of drugs, dosage forms and routes of administration.
c. Pharmacokinetics – absorption, distribution, metabolism, excretion of drugs.
d. Factors modifying drug action.
e. Drug interactions.
f. Adverse drug reactions.
g. Drug dependence, addiction, tolerance, allergy, idiosyncrasy.
h. Enzyme induction and inhibition.
i. Bioavailability and first pass metabolism.

Unit II: Pharmacodynamics & Drug Safety **12Hours**

a. Principles of drug action – receptor theory, drug–receptor interaction, dose-response relationships.
b. Mechanism of drug action – signal transduction mechanisms (ion channel, G-protein coupled, enzyme-linked receptors).
c. Therapeutic index, drug antagonism and synergism.
d. Adverse drug reactions – types A and B.
e. Drug interactions – pharmacokinetic and pharmacodynamic.
f. Drug discovery and development – preclinical and clinical trials, phases of clinical trials.
g. Pharmacovigilance.

Unit III: Drugs Acting on Peripheral Nervous System **10Hours**

a. Peripheral nervous system – organization and neurotransmission.
b. Parasympathomimetics and parasympatholytics.
c. Sympathomimetics and sympatholytics.
d. Neuromuscular blockers and skeletal muscle relaxants.
e. Local anesthetics.
f. Drugs used in myasthenia gravis and glaucoma.

Unit IV: Drugs Acting on Central Nervous System **8Hours**

a. Neurotransmitters in the CNS.
b. General anesthetics and pre-anesthetic medication.
c. Sedatives and hypnotics.
d. Centrally acting muscle relaxants.
e. Antiepileptics.
f. Alcohol and disulfiram.

Unit V: Drugs Acting on Central Nervous System **7Hours**

a. Antipsychotic drugs.
b. Antidepressants.
c. Anxiolytic and antimanic agents.
d. Drugs used in Parkinson's and Alzheimer's diseases.
e. CNS stimulants and nootropics.
f. Opioid analgesics and antagonists.
g. Drug dependence and abuse.

TEXT BOOKS:

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier

2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill

REFERENCES:

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

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

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/**

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PHARMACOLOGY-I PRACTICAL

SUBJECT CODE: 2513PY39

COURSE OBJECTIVES: On completion of this course, the student will able to

COB1: To gain knowledge of instruments and laboratory animals used in Experimental Pharmacology

COB2: To understand the practical aspects of Common laboratory techniques used for animal studies, different routes of drug administration in mice/rats, and pharmacological actions of different categories of drugs.

COB1: Understand the pharmacological actions of different categories of drugs

COB2: Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.

COB3: Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.

COB4: Observe the effect of drugs on animals by simulated experiments

COB5: Appreciate correlation of pharmacology with other bio medical sciences

COURSE OUTCOMES

CO1 : Summarize the basic concept of Pharmacology.

CO2: Demonstrate the effect of drugs on animals by using simulated experiments.

CO3: Adapt knowledge about recent developments in Pharmacology.

CO4: Relate the in vivo and in vitro experiments, and use of software for the study of experiments.

CO5: Construct correlation of Pharmacology with other bio-medical sciences.

CO6: Evaluate the therapeutic efficacy and safety of drugs through critical analysis of experimental data.

Mapping of Course Outcomes with Program Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3	1	2	2		2	2	2	3	2	3
CO 2	3	1	2	2		2	2	2	3	2	3
CO 3	3	1	2	2		2	2	2	3	2	3
CO 4	3	1	2	2		2	2	2	3	2	3
CO 5	3	1	2	2		2	2	2	3	2	3
CO6				1	1						

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content 4Hrs/Week

LIST OF EXPERIMENTS

Exp. No.	Title of the Experiment	CO
1	Introduction to experimental pharmacology.	**CO 1**
2	Commonly used instruments in experimental pharmacology.	**CO 1**
3	Study of common laboratory animals	**CO 1**
4	Maintenance of laboratory animals as per CPCSEA guidelines	**CO 2**
5	Common laboratory techniques. Blood withdrawal, serum, and plasma separation, Anaesthetics and euthanasia are used for animal studies.	**CO 2**
6	Study of different routes of drug administration in mice/rats.	**CO 2**
7	Study of the effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.	**CO 2**
8	Effect of drugs on ciliary motility of Frog Oesophagus	**CO 2**
9	Effect of drugs on rabbit eye.	**CO 2**
10	Effects of skeletal muscle relaxants using rota-rod apparatus.	**CO 2**
11	Effect of drugs on Locomotor Activity using actophotometer	**CO 2**
12	Anticonvulsant effect of drugs by MES and PTZ method	**CO 2**
13	Study of stereotype and anti-catatonic activity of drugs on rats/mice.	**CO 4**
14	Study of anxiolytic activity of drugs using rats/mice.	**CO 4**
15	Study of local anaesthetics by different methods	**CO 4**

Text books

1. Tripathi, K. D. Essentials of medical pharmacology. 4th Ed, 1999. Publisher: Jaypee, Delhi.
2. Satoskar, R.S. and Bhadarkar, S.D. Pharmacology and pharmacotherapeutics. 16th edition (single volume), 1999. Publisher: Popular, Dubai.

Reference books

1. 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.
2. Craig, C.R. & Stitzel, R.E. Modern Pharmacology. Latest edition. Publisher: Little Brown.Co
3. Katzung, B.G. Basic and clinical pharmacology. Latest edition. Publisher: Prentice Hall, Int.

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/

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PHARMACOGNOSY AND PHYTOCHEMISTRY I

Course Code: 2513PY36

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

COB1: Understand the history, scope, sources, classification, and quality control of crude drugs.
COB2: Learn the cultivation, processing, and conservation of medicinal plants.
COB3: Explore plant tissue culture and its applications in Pharmacognosy.
COB4: Appreciate the role of Pharmacognosy in traditional systems of medicine and identify major secondary metabolites.
COB5: Describe the sources, chemical nature, and therapeutic uses of selected primary metabolites, fibres, and marine drugs.

Course Outcomes: At the end of the course students will be able to
CO1: Classify and evaluate crude drugs using organoleptic, microscopic, and chemical techniques.
CO2: Describe cultivation, processing, and conservation of medicinal plants.
CO3: Explain the principles and applications of plant tissue culture in the field of Pharmacognosy.
CO4: Identify major classes of secondary metabolites and their significance in traditional and modern medicine.
CO5: Analyze primary metabolites and marine drugs in terms of source, chemistry, storage, and therapeutic utility.
CO6: Apply pharmacognostic principles for the authentication, standardization, and evaluation of herbal medicines used in the pharmaceutical industry.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **45 Hours**

UNIT-I **10 Hours**

Introduction to Pharmacognosy:

(a) Definition, history, scope and development of Pharmacognosy

(b) Sources of Drugs – Plants, Animals, Marine & Tissue culture

(c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).

Classification of drugs:

Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and chemotaxonomical classification of drugs

Quality control of Drugs of Natural Origin:

Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties.

Quantitative microscopy of crude drugs including lycopodium spore method, leaf constants, camera Lucida and diagrams of microscopic objects to scale with camera Lucida.

UNIT-II **10 Hours**

Cultivation, Collection, Processing and storage of drugs of natural origin:

Cultivation and Collection of drugs of natural origin.

Factors influencing cultivation of medicinal plants.

Plant hormones and their applications.

Polyploidy, mutation and hybridization with reference to medicinal plants

Conservation of medicinal plants

UNIT-III **07 Hours**

Plant tissue culture:

Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance.

Applications of plant tissue culture in Pharmacognosy.

Edible vaccines.

UNIT IV **10 Hours**

Pharmacognosy in various systems of medicine:

Role of Pharmacognosy in Allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine.

Introduction to secondary metabolites:

Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins.

UNIT V **08 Hours**

Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs.

Plant Products:

Fibers - Cotton, Jute, Hemp

Hallucinogens, Teratogens, Natural allergens

Primary metabolites:

General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites:

Carbohydrates: Acacia, Agar, Tragacanth, Honey

Proteins and Enzymes: Gelatine, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin).

Lipids (Waxes, fats, fixed oils): Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax

Marine Drugs:

Novel medicinal agents from marine sources

Text Books:

1. Mohammad Ali, *Pharmacognosy and Phytochemistry*, CBS Publishers.
2. C.K. Kokate, Purohit, Gokhale, *Textbook of Pharmacognosy*, 37th ed., Nirali Prakashan.

Reference Books:

1. V.E. Tyler, L.R. Brady, J.E. Robbers, *Pharmacognosy*, 9th ed., Lea & Febiger.
2. T.E. Wallis, *Textbook of Pharmacognosy*.
3. S.H. Ansari, *Essentials of Pharmacognosy*, Birla Publications.

Web Links:

W1: https://pharmaguideline.com/2019/04/crude-drug-classification-evaluation.html
W2: https://www.pharmatutor.org/articles/methods-of-cultivation-collection-processing-of-medicinal-plants
W3: https://www.biologydiscussion.com/biotechnology/plant-tissue-culture-biotechnology/
W4: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4264231/
W5: https://www.pharmaguideline.com/2021/10/secondary-metabolites-types-and-functions.html

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PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)

Course Code: 2513PY40

Course Objective:

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

COB1: Develop skills in microscopic evaluation of crude drugs.

COB2: Perform chemical tests for identification of phytoconstituents.

COB3: Understand chromatographic techniques for herbal drug analysis.

COB4: Demonstrate proper methods for extraction and isolation of phytochemicals.

COB5: Apply pharmacognostic techniques for standardization of crude drugs.

Course Outcomes (CO's):

At the end of the course students will be able to:

CO1: Identify and evaluate crude drugs by organoleptic and microscopic characters.

CO2: Carry out chemical tests for secondary metabolites (alkaloids, glycosides, tannins, etc.).

CO3: Employ chromatographic methods for the analysis of crude drugs.

CO4: Prepare herbal extracts using conventional methods.

CO5: Standardize herbal drugs using qualitative and quantitative parameters.

CO6: Demonstrate understanding of quality control and regulatory guidelines applicable to herbal drug evaluation and formulation.

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	1	3	2	2	2	2
CO2	3	2	3	2	2	2	3	2	2	2	2
CO3	3	2	3	3	2	2	2	2	2	2	2
CO4	3	2	2	3	2	2	2	2	2	2	2
CO5	3	2	3	2	3	2	2	2	2	2	3
CO6	3	2	2	2	2	1	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

Course Content **4 Hours / Week**

List of Experiments:

Expt. No	Title	CO
1.	Analysis ofcrude drugs bychemicaltests: (i)Tragacanth (ii) Acacia (iii)Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil	CO1
2.	Determination ofstomatal number and index	CO1
3.	Determinationofvein islet number, vein islet termination and palisade ratio.	CO2
4.	Determination ofsize of starch grains, calcium oxalate crystals by eye piece Micrometer	CO3
5.	Determination ofFiber length and width	CO2
6.	Determinationof number ofstarch grains by Lycopodium spore method	CO5
7.	Determination of Ash value	CO4
8.	Determination ofExtractive values ofcrude drugs	CO2
9.	Determinationof moisture content ofcrude drugs	CO4
10.	Determination ofswelling index and foaming	CO4

Text Books:

1. C.K. Kokate, Purohit, Gokhale, Textbook of Pharmacognosy, Nirali Prakashan.
2. Mohammad Ali, Pharmacognosy and Phytochemistry, CBS Publishers.

Reference Books:

1. V.E. Tyler, L.R. Brady, J.E. Robbers, Pharmacognosy, Lea & Febiger.
2. T.E. Wallis, Textbook of Pharmacognosy.
3. S.H. Ansari, Essentials of Pharmacognosy, Birla Publications.

Web Links:

W1: https://pmc.ncbi.nlm.nih.gov/articles/PMC7398001/
W2: https://www.orientjchem.org/vol39no3/qualitative-phytochemical-screening-of-medicinal_plants-using-different-solvent-extracts/
W3: https://www.mdpi.com/1420-3049/27/19/6607
W4:https://www.researchgate.net/publication/333647843_Techniques_for_Extraction_Isolation_and_Standardization_of_Bioactive_Compounds_from_Medicinal_Plants
W5: https://www.jove.com/t/51411/thin-layer-chromatographic-tlc-separations-bioassays-plant-extracts

SEMESTER V

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Pharmaceutical medicinal chemistry-II

SUBJECT CODE: 2513PY41

Course Objectives: 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: Describe the chemistry of antihistaminic agents with respect to pharmacological activity. To understand the concept of cancer and anti-neoplastic agents chemistry

CO2: Explain the drug metabolic pathways, adverse effect and therapeutic value of antianginal drugs, vasodilators and calcium channel blockers. Diuretics classification, MOA and SAR of anti-hypertensive agents

CO3: Classify about cardiovascular diseases and drugs to treat cardiovascular problems

CO4: Explain the nomenclature, stereochemistry and metabolism of steroids and drugs acting on endocrine system

CO5: Classify and the anti-diabetic agents and explain the preparation of drugs

CO6: Synthesis of antidiabetic agents and SAR of local anaesthetics.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **45 HRS**

UNIT-I 10 Hours

Antihistaminic agents: Histamine, receptors and their distribution in the human body
H1–antagonists: Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamine succinate, Clemastinefumarate, Diphenylpyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniraminemaleate, Triprolidine hydrochloride*, Phenindamine tartrate, Promethazine hydrochloride*, Trimeprazinetartrate, Cyproheptadine hydrochloride, Azatidinemaleate, Astemizole, Loratadine, Cetirizine, Levocetirizine, Cromolyn sodium.
H2-antagonists: Cimetidine*, Famotidine, Ranitidine Gastric Proton pump inhibitors: Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole, esomeprazole.
Anti-neoplastic agents: Alkylating agents: Mechlorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa.
Antimetabolites: Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine
Antibiotics: Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin
Plant products: Etoposide, Vinblastine sulphate, Vincristine sulphate
Miscellaneous: Cisplatin, Mitotane.

UNIT– II 10 Hours

Anti-anginal:
Vasodilators: Amyl nitrite, Nitro-glycerine*, Pentaerythritol tetranitrate, Isosorbide dinitrate*, Dipyridamole.
Calcium channel blockers: Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.
Diuretics:
Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide.
Thiazides: Chlorothiazide*, Hydrochlorothiazide, Hydro flumethiazide, Chlorothiazide, Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid.
Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride.
Osmotic Diuretics: Mannitol
Anti- hypertensive Agents:
Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride, *Clonidine hydrochloride, Guanethidine mono sulphate, Guanabenzacetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.

UNIT-III 10 Hours
Anti-arrhythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol.
Anti-hyper lipidemic agents: Clofibrate, fenofibrate, gemfibrozil, Atorvastatin, Rosuvastatin, Lovastatin, Simvastatin, Cholestyramine and Cholestipol.
Coagulant & Anticoagulants: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel.
Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.

UNIT-IV 08 Hours

Drugs acting on Endocrine system
Nomenclature, Stereo chemistry and metabolism of steroids
Sex hormones: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrone, Diethylstilbesterol.
Drugs for erectile dysfunction: Sildenafil, Tadalafil.
Oral contraceptives: Mifepristone, Norgestril, Levonorgestrol
Corticosteroids: Cortisone, Hydrocortisone, Prednisolone Betamethasone, Dexamethasone
Thyroid and antithyroid drugs: L-Thyroxine, Triiodothyronine, L-Thyronine, Propylthiouracil, Methimazole.

UNIT– V 07 Hours
Anti diabetic agents: Insulin and its preparations
Sulfonylureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride, Glibenclamide.
Biguanides: Metformin.
Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide.
Glucosidase inhibitors: Acarbose, Voglibose.
Local Anaesthetics: SAR of Local anaesthetics
Benzoic Acid derivatives; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine.
Amino Benzoic acid derivatives: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate.
Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine, Bupivacaine
Miscellaneous: Phenacaine, Diperodon, Dibucaine. *

Text Books:

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.

Reference Books:

1. Burger's Medicinal Chemistry, Vol I to IV.
2. Introduction to principles of drug design-Smith and Williams.
3. Remington's Pharmaceutical Sciences.

Web Resources:

W1:https://www.sips.org.in/wp-content/uploads/2021/06/MEDICINAL-CHEMISTRY-OF-ANTIHISTAMINIC-AGENTS_BP501TT.pdf

W2: https://www.slideshare.net/pankajrana87/antianginal-drug-88309899

W3:https://www.iptsalipur.org/wp-content/uploads/2020/08/BP501T_MEDCHEM_-UNIT-_III.pdf

W4:https://www.iptsalipur.org/wp-content/uploads/2020/08/BP501T_MEDCHEM_-UNIT-_IV.pdf

W5:https://www.ncbi.nlm.nih.gov/books/NBK513225/

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INDUSTRIAL PHARMACY I (Theory)

Course Code: 2513PY42
Course Objective: Upon completion of the course the student shall be able to
COB 1: Know the various pharmaceutical dosage forms and their manufacturing techniques.
COB 2: Know various considerations in development of pharmaceutical dosage forms
COB 3: Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality.

Course Outcomes: At the end of the course students will be able to
CO1: Illustrate preformulation
CO2: Interpret pharmaceutical dosage forms and their manufacturing techniques
CO3: Develop pharmaceutical dosage forms
CO4: Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality
CO5: Formulate cosmetics, pharmaceutical aerosols
CO6: Formulate cosmetics, pharmaceutical aerosols

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes

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

Course Content: **45 Hours**

UNIT- I **10 Hours**

Antihistaminic agents: Histamine, receptors and their distribution in the human body
H1–antagonists: Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamine succinate, Clemastine fumarate, Diphenylpyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenindamine tartarate,

Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine, Cromolyn sodium.
H2-antagonists: Cimetidine*, Famotidine, Ranitidine
Gastric Proton pump inhibitors: Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole, esomeprazole
Anti-neoplastic agents:
Alkylating agents: Meclorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa
Antimetabolites: Mercaptopurine*,Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine
Antibiotics: Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin **Plant products:** Etoposide, Vinblastin sulphate, Vincristin sulphate **Miscellaneous:** Cisplatin, Mitotane.

UNIT – II **10 Hours**
Anti-anginal:
Vasodilators: Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole.
Calcium channel blockers: Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.
Diuretics:
Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide. Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, cyclothiazide, Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid.
Potassiumsparing Diuretics: Spironolactone, Triamterene, Amiloride. Osmotic Diuretics: Mannitol
Anti-hypertensive Agents: Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.

UNIT- III **10 Hours**
Anti-arrhythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol.
Anti-hyperlipidemic agents: Clofibrate, fenofibrate, gemfibrozil, Atorvastatin, Rosuvastatin, Lovastatin, Simvastatin, Cholesteramine and Cholestipol.
Coagulant & Anticoagulants: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel.
Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.

UNIT- IV **08 Hours**

Drugs acting on Endocrine system
Nomenclature, Stereochemistryand metabolism of steroids
Sex hormones: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrone, Diethylstilbestrol.
Drugs forerectile dysfunction: Sildenafil, Tadalafil.
Oralcontraceptives: Mifepristone, Norgestril, Levonorgestrol
Corticosteroids: Cortisone, Hydrocortisone, Prednisolone Betamethasone, Dexamethasone
Thyroid and antithyroid drugs: L-Thyroxine, Triiodothyronine, L-Thyronine, Propylthiouracil, Methimazole.

UNIT – V **07 Hours**

Antidiabetic agents:
Insulin and its preparations
Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride, Glibenclamide. Biguanides: Metformin.
Thiazolidinediones: Pioglitazone,Rosiglitazone. Meglitinides: Repaglinide, Nateglinide.
Glucosidase inhibitors: Acrabose, Voglibose.
Local Anesthetics: SAR of Local anaesthetics
Benzoic Acid derivatives; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine.
Amino Benzoic acid derivatives: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate.
Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine, Bupivacaine
Miscellaneous: Phenacaine, Diperodon, Dibucaine.*

Textbooks:
1. The theory and practice of Industrial Pharmacy by Libermann and Lachmann
2. Ansels Pharmaceutical Dosage form and drug Delivery system by Loyd. N. Allen, J.R

Reference Books:

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman & J. B. Schwartz.
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman. Copper and Gunn's Dispensing for pharmaceutical students byS J Carter.

Web Links:
W1: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7250125/

W2: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9958669/

W3:https://www.who.int/docs/default-source/medicines/norms-and-standards/guidelines/production/trs1019-annex3-gmp-validation.pdf

W4: https://www.slideshare.net/slideshow/cgmp-and-industrial-management/245604822

W5: https://course.cutm.ac.in/courses/modern-pharmaceutics-cutm1585/

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INDUSTRIAL PHARMACY - I (Practical)

Subject Code: 2513PY46

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

COB1: Know the various pharmaceutical dosage forms and their manufacturing techniques.

COB2: Know various considerations in development of pharmaceutical dosage forms

COB3: Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality.

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

CO1: Evaluate preformulation studies of paracetamol/aspirin/or any other drug.

CO2: Preparation and Evaluation of Solid dosage forms and coating of tablets.

CO3: Formulate and evaluate the capsules and parenteral dosage forms.

CO4: Evaluation tests (Quality control tests (as per IP)) for marketed tablets and capsules.

CO5: Formulate the Eye drops/ and Eye ointments, Creams (cold / vanishing cream).

CO6: Evaluation of Glass containers (as per IP).

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	1	1	1	1	1	1	1
CO2	3	3	3	2	3	2	1	1	2	2	1
CO3	3	3	3	2	3	2	1	1	2	2	1
CO4	3	2	3	2	2	2	1	1	1	2	2
CO5	3	3	3	2	3	2	1	1	2	2	1
CO6	3	2	2	2	2	3	2	1	1	2	2

Mapping of Course Outcomes with Program Specific Outcomes

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

Course Content **4 Hours / Week**

List Of Experiments:

Expt. No	TITLE	CO
1.	Preparation of Paracetamol tablets by wet Granulation method	**CO1**
2.	Evaluation of Formulated Paracetamol Tablets	**CO2**
3.	Formulation of soluble Acetyl Salicylic acid tablets	**CO2**
4.	Evaluation of Formulated Acetyl Salicylic Acid Tablets	**CO2**
5.	Preparation & Evaluation of Tetracycline Capsules	**CO2**
6.	Formulation of Ascorbic Acid Injection	**CO3**

7.	Formulation of Calcium Gluconate Injection	**CO3**
8.	Evaluation of Marketed Paracetamol Tablets	**CO4**
9.	Evaluation of Marketed Loperamide Capsules	**CO4**
10.	Preparation & Evaluation of Chloramphenicol Eye ointment	**CO5**
11.	Preparation & Evaluation of Pilocarpine Eye Drops	**CO5**
12.	Preparation of Cold Creams	**CO5**
13.	Preparation of Vanishing Cream	**CO5**
14.	Preparation of Face powder	**CO5**
15.	Evaluation of Glass Containers	**CO6**
16.	Film coating of Compressed Tablets	**CO2**

Textbooks:

1. Preparation Pharmaceutical dosage forms - Tablets, volume 1 -3 byH.A. Liberman, Leon Lachman & J. B. Schwartz.
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman.

Reference Books:

1. Pharmaceutical dosage form disperse systemVOL-1 by Liberman & Lachman
2. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
3. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)

Web Links:

W1:https://pharmacy.kkwagh.edu.in/uploads/study_material/TY%20-%20IP%20I%20-%20Preformulation%20studies.pdf
W2: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9415771/
W3: https://www.wjpls.org/download/article/54072020/1596196393.pdf
W4:https://www.slideshare.net/slideshow/quality-control-tests-for-parenterals-ppt/56151020
W5: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7155167/

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PHARMACOLOGY – II (Theory)

SUBJECT CODE: 2513PY43

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

COB1: Understand the mechanism of drug action and its relevance in the treatment of different diseases

COB2: Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments

COB3: Demonstrate the various receptor actions using isolated tissue preparation

COB4: Appreciate correlation of pharmacology with related medical sciences

Course outcomes: At the end of the course students will be able to

CO1: Write the fundamentals of regulatory processes, pathophysiology in relation to CVS illnesses and disorders, and the pharmacology of drugs used to treat CVD.

CO2: Illustrate the drugs acting on hematopoietic system, shock, diuretics and antidiuretics.

CO3: Discuss the synthesis, metabolism, and pharmacology of autocoids.

CO4: Explain the pharmacology and rational use of drugs used for the treatment of various endocrine disorders.

CO5: Appraise the physiological role of sex hormones and to assess the effects of oral contraceptives and drugs acting on the Uterus

CO6: Describe the principles, applications and types of bioassays, Evaluate the potency of unknown compound with reference to standard.

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	1	1	1	1	1	1	1
CO2	3	3	3	2	3	2	1	1	2	2	1
CO3	3	3	3	2	3	2	1	1	2	2	1
CO4	3	2	3	2	2	2	1	1	1	2	2
CO5	3	3	3	2	3	2	1	1	2	2	1
CO6	3	2	2	2	2	3	2	1	1	2	2

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

Course Content: **45HRS**

UNIT-I **10hours**

1. Pharmacology of drugs acting on cardio vascular system

a. Introduction to hemodynamic and electrophysiology of heart.
b. Drugs used in congestive heart failure
c. Anti-hypertensive drugs.
d. Anti-anginal drugs.
e. Anti-arrhythmic drugs.
f. Anti-hyperlipidemic drugs.

UNIT-II **10hours**

1. Pharmacology of drugs acting on cardio vascularsystem

a. Drug used in the therapyofshock.
b. Hematinics, coagulants and anticoagulants.
c. Fibrinolytics and anti-platelet drugs
d. Plasma volume expanders

2. Pharmacology of drugs acting on urinary system

a. Diuretics
b. Anti-diuretics.

UNIT-III **10hours**

Autocoids and related drugs

a. Introductionto autacoids and classification
b. Histamine, 5-HT and their antagonists.
c. Prostaglandins, Thromboxanes and Leukotrienes.
d. Angiotensin, Bradykinin and Substance P.
e. Non-steroidal anti-inflammatory agents
f. Anti-gout drugs
g. Antirheumatic drugs

UNIT-IV **08hours**

Pharmacology of drugs acting on endocrine system

a. Basic concepts in endocrine pharmacology.
b. Anterior Pituitaryhormones- analogues and their inhibitors.
c. Thyroid hormones- analogues and their inhibitors.
d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D.
e. Insulin, Oral Hypoglycemic agents and glucagon.
f. ACTH and corticosteroids.

UNIT-V **07hours**

Pharmacology of drugs acting on endocrine system

a. Androgens and Anabolic steroids.
b. Estrogens, progesterone and oralcontraceptives.
c. Drugs acting onthe uterus.

Bioassay

a. Principles and applications ofbioassay. b. Types of bioassays

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

Text books:

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw- Hill.
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics

Reference books

1. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley.
2. R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins.
3. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.

Web links :

W1 : https://archive.org/details/PharmacologyLippincottsIllustratedReviewsSeries5thEdition

W2: https://www.slideshare.net/slideshow/kd-tripathi-classification-of-drugspptx/254070843

W3: https://www.scribd.com/document/749066483/KD-Tripathi-Drug-Classification-Handbook

W4: https://www.slideshare.net/slideshow/antibiotics-detailed-study-pharmacology-academic-purpose/238358658.

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PHARMACOLOGY –II (Practical)

SUBJECT CODE: 2513PY47

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

COB1: Understand the mechanism of drug action and its relevance in the treatment of different diseases

COB2: Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments

COB3: Demonstrate the various receptor actions using isolated tissue preparation

COB4: Appreciate correlation of pharmacology with related medical sciences

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

CO1: Explain in-vitro pharmacological studies, importance of physiological salt solutions and to find out effect of various drugs isolated frog heart, BP & heart rate in laboratory animals

CO2: Illustrate the diuretic activity of drugs in mice/rats

CO3: Demonstrate the Dose Response Relationship, effect of drugs DRC and find out concentrations of drugs various Bioassay methods

CO4: Determine the PA2 & PD2 value of drugs using rat anococcygeus muscle and guinea pig ileum

CO5: Interpret the effect of spasmogens and spasmolytic using rabbit jejunum

CO6: Predict various screening models for analgesic and anti-inflammatory activities.

Mapping of Course Outcomes with Program Outcomes:

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

Course Content **4 Hours / Week**

List of Experiments:

Expt. No	Title	CO
1.	Introduction to *in-vitro* pharmacology and physiological salt solutions.	CO1
2.	Effect of drugs on isolated frog heart.	CO2
3.	Effect of drugs on blood pressure and heart rate of dog.	CO2
4.	Study of diuretic activity of drugs using rats/mice.	CO2
5.	DRC of acetylcholine using frog rectus abdominis muscle.	CO2
6.	Effect ofphysostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively.	CO3
7.	Bioassay of histamine using guinea pig ileum by matching method.	CO4
8.	Bioassay of oxytocin using rat uterine horn by interpolation method.	CO4
9.	Bioassay of serotonin using rat fundus strip by three point bioassay.	CO4
10.	Bioassay of acetylcholine using rat ileum/colon by four point bioassay.	CO4
11.	Determination of PA_2 value of prazosin using rat anococcygeus muscle (by Schilds plot method).	CO5
12	Determination of PD_2 value using guinea pig ileum.	CO6
13.	Effect of spasmogens and spasmolytics using rabbit jejunum.	CO5
14	Anti-inflammatory activity of drugs using carrageenan induced paw-edema model.	CO7
15	Analgesic activityof drug using central and peripheral methods	CO8

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

Textbooks:

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw- Hill.

Reference books:

1. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.
2. K.D.Tripathi. Essentials ofMedicalPharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
3. Sharma H. L., Sharma K. K., Principles ofPharmacology, Paras medical publisher

Weblinks:

W1 : https://archive.org/details/PharmacologyLippincottsIllustratedReviewsSeries5thEdition.

W2: https://www.slideshare.net/slideshow/kd-tripathi-classification-of-drugspptx/254070843

W3: https://www.scribd.com/document/749066483/KD-Tripathi-Drug-Classification-Handbook

W4:https://www.slideshare.net/slideshow/antibiotics-detailed-study-pharmacology-academic-purpose/238358658

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PHARMACOGNOSY AND PHYTOCHEMISTRY II (Theory)

Subject Code: 2513PY44

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: Describe herbal raw materials as source of herbal drugs from cultivation to herbal products.

CO2: Explain the composition, chemistry, chemical classes, chemical constituents and therapeutic &commercial uses of crude drugs.

CO3: Experimental isolation and identification tests of chemical classes of crude drugs

CO4: Analyse the various classes of phytochemical constituents present in crude drugs

CO5: Evaluation and estimation of phytochemical constituents and their industrial production.

CO6: Design various modern methods of extraction.

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	1
CO2	2	3
CO3	3	2
CO4	3	2
CO5	3	1
CO6	3	1

Course Content **45 Hours**

Unit I **7 hours**

Metabolic pathways in higher plants and their determination

a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway.

b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.

UNIT-II **14 Hours**

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

secondary metabolites:

Alkaloids: Vinca, Rauwolfia, Belladonna, Opium**,**

Phenylpropanoids and Flavonoids: Lignans, Tea, Ruta

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

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

Tannins: Catechu, Pterocarpus

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

Glycosides: Senna, Aloes, Bitter Almond

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

UNIT-III **6 Hours**

Isolation, Identification and Analysis of Phytoconstituents

a) Terpenoids: Menthol, Citral, Artemisin

b) Glycosides: Glycyrhetinic acid & Rutin

c) Alkaloids: Atropine, Quinine, Reserpine, Caffeine

d) Resins: Podophyllotoxin, Curcumin

UNIT-IV **10 Hours**

Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine

UNIT V **8 Hours**

Basics of Phytochemistry

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

Text Books:

1. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37thEdition, Nirali Prakashan, New Delhi.
2. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.

Reference Books:

1. W.C.Evans, Trease and Evans Pharmacognosy, 16thedition, W.B. Sounders & Co., London, 2009.
2. MohammadAli. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.

Web Links:

W1:https://www.pharmaacademias.com/digitalis-general-introduction-composition-chemistry-bio-sources-therapeutic-uses-and-commercial-applications/

W2: https://ansaripharmaeducation.blogspot.com/2024/09/pharmacognosy-phytochemistry-ii-unit.html

W3: https://askfilo.com/user-question-answers-science/unit-iii-isolation-identification-and-analysis-of-363239333834

W4: https://uvdpharmacognosy.blogspot.com/2022/10/unit-iii-isolation-identification-and.html

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PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical)

Code: 2513PY48

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

COB1: Understand procedures for extraction, isolation, and analysis of phytoconstituents.
COB2: Gain practical exposure to chemical tests and chromatographic techniques.
COB3: Quantify phytoconstituents using classical and instrumental methods.
COB4: Validate quality parameters for herbal products.
COB5: Apply WHO guidelines and analytical principles in quality control of herbal drugs.

Course Outcomes (CO's): At the end of the course students will be able to:

CO1: Explain the methods for preparation and standardization of herbal extracts.
CO2: Perform identification tests for major phytoconstituent groups.
CO3: Isolate phytoconstituents using conventional laboratory techniques.
CO4: Conduct chromatographic analysis of plant constituents.
CO5: Apply quantitative estimation methods for phytoconstituents.
CO6: Evaluate quality control parameters and interpret regulatory standards.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **4 Hours / Week**

List of Experiments:

S.N	Name of the experiment	CO'S
1.	Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander	**CO1**
2.	Exercise involving isolation & detection of active principles a. Caffeine – from tea dust. b. Diosgenin fromDioscorea c. Atropine from Belladonna d. Sennosides fromSenna	**CO2**
3.	Separation of sugars by Paper chromatography	**CO3**
4.	TLC of herbal extract	**CO5**
5.	Distillation of volatile oils and detection of phytoconstituents by TLC	**CO6**
6.	Analysis of crude drugs by chemical tests: **i.** Asafoetida **ii.** Benzoin **iii.** Colophony **iv.** Aloes **v.** Myrrh	**CO4**

Text Books:

1. Mohammad Ali, Pharmacognosy and Phytochemistry, CBS Publishers.
2. Kokate, Purohit, Gokhale, Textbook of Pharmacognosy, Nirali Prakashan.
3. Trease and Evans, Pharmacognosy, Saunders.

Reference Books:

1. V.E. Tyler, L.R. Brady, J.E. Robbers, Pharmacognosy, Lea & Febiger.
2. S.H. Ansari, Essentials of Pharmacognosy, Birla Publications.
3. Y.R. Sharma, Elementary Organic Spectroscopy, S. Chand.

Web Links:

W1: https://pharmaguideline.com/2020/01/phytochemical-screening-methods.html
W2: https://www.pharmatutor.org/articles/phytoconstituent-extraction-isolation-methods
W3: https://www.biologydiscussion.com/phytochemistry/tlc-technique-for-plant-constituents/20401
W4: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4033816/
W5: https://www.who.int/publications/i/item/9241546271

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PHARMACEUTICAL JURISPRUDENCE (Theory)

SUBJECT CODE: 2513PY45

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

COB1: The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.

COB2: Various Indian pharmaceutical Acts and Laws.

COB3: The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals.

COB4: The code of ethics during the pharmaceutical practice.

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

CO1: Discuss about Drugs act, Import, Manufacture ofdrugs, and its license.

CO2: Demonstrate Various Schedules, labelling and packing, offences and penalties.

CO3: Illustrate the Pharmacy Act, Medicinal and Toilet Preparation Act.

CO4: Demonstrate Narcotic Drugs and Psychotropic substances Act.

CO5: Describe the Salient Features of Drugs and Magic Remedies Act, Prevention of Cruelty acts and National Pharmaceutical Pricing Authority.

CO6: Discuss Various Pharmaceutical legislation, code, medical termination and Intellectual property rights.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content: **45 Hours**

UNIT-I **10 Hours**

Drugs and Cosmetics Act, 1940 and its rules 1945:

Objectives, Definitions, Legal definitions of schedules to the Act and Rules

Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties**.**

Manufacture of drugs – Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.

UNIT-II **10 Hours**

Drugs and Cosmetics Act, 1940 and its rules 1945.

Detailed study of Schedule G, H, M, N, P, T, U, V, X, Y, Part XII B, Sch F & DMR (OA) Sale of Drugs – Wholesale, Retail sale and restricted license. Offences and penalties.

Labelling & Packing of drugs- General labelling requirements and specimen labels for drugs and cosmetics, List of permitted colours. Offences and penalties.

Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, licensing authorities, controlling authorities, Drugs Inspectors.

UNIT-III **10 Hours**

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

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

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

UNIT-IV **08 Hours**

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

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

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

UNIT-V **07 Hours**

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

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

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

Text Books:

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

Reference Books:

1. Hand book of drug law-by M.L. Mehra
2. A text book of Forensic Pharmacy by N.K. Jain
3. Drugs and Cosmetics Act/Rules by Govt. Of India publications.

Web Links:

W1: **https://custada.in/CUSTADA-Online/document/document/COSMETICS_POLICY.htm**

W2: **https://www.indiafilings.com/learn/import-of-drugs-and-cosmetics/**

W3. **https://ipindia.gov.in/writereaddata/Portal/IPOAct/1_31_1_patent-act-1970-11march2015.pdf**

W4: **https://www.sciencedirect.com/science/article/abs/pii/S2214420X15000480**

W5: **https://ipapharma.org/code-of-pharmaceutical-ethics/**

SEMESTER VI

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MEDICINALCHEMISTRY–III (Theory)

SUBJECT CODE: 2513PY50

COURSE OBJECTIVE: Upon completion of the subject student shall be able to

COB1: Understand the importance of drug design and different techniques of drug design.

COB2: Understand the chemistry of drugs with respect to their biological activity.

COB3: Know the metabolism, adverse effects and therapeutic value of drugs.
COB4: Know the importance of SAR of drugs.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Characterise the history, classification of antibiotics
CO2: Illustrate chemical degradation, MOA, SAR of antibiotics
CO3: Applications of Prodrugs, Synthesize of antimarlarial
CO4: Synthesize the Anti T.B agents, UTI, Antiviral& importance of antifungal , antiprotozoal
CO5: Justify the Synthesis of Antihelmintics &sulphonamides
CO6: Explain Various approaches used in drug design and Pharmacophore modeling and docking techniques

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **45 Hours**

UNIT-I **10 Hours**

Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation, classification and important products of the following classes.

β-Lactam antibiotics: Penicillin, Cephalosporins, β- Lactamase inhibitors, Monobactams

Aminoglycosides: Streptomycin, Neomycin, Kanamycin, Clindamycin

Tetracyclines: Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline

UNIT-II **I0 Hours**

Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation, classification and important products of the following classes.

Macrolide: Erythromycin, Clarithromycin, Azithromycin, Roxithromycin, Telithromycin

Miscellaneous: Chloramphenicol*.

Prodrugs: Basic concepts and application of prodrug design.

Antimalarials: Etiology of malaria.

Quinolines: SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine.

Biguanides and dihydrotriazines: Cycloguanilpamoate, Proguanil.

Miscellaneous: Pyrimethamine, Artesunete, Artemether, Atovoquone.

UNIT– III **10 Hours**

Anti-tubercular Agents

Synthetic anti tubercular agents: Isoniazid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylicacid.*

Anti tubercular antibiotics: Rifampicin, Rifabutin, Cycloserine Streptomycin, Capreomycin sulphate.

Urinary tract anti-infective agents

Quinolones and fluoroquinolines: SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin*, Levofloxacin, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin

Miscellaneous: Furazolidine, Nitrofurantoin*, Methanamine.

Antiviral agents:

Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridinetrifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirdin, Ribavirin, Saquinavir, Indinavir, Ritonavir

UNIT– IV **8 Hours**

Anti-fungal agents:

Anti fungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin.

Synthetic Anti fungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole, Tioconozole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifinehydrochloride, Tolnaftate*.

Anti-protozoal Agents: Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine.

Anthelmintics: Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*,Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin.

Sulphonamides and Sulfones

Historical development, chemistry, classification and SAR of Sulphonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxaole*, Sulphadiazine, Mefenideacetate, Sulfasalazine.

Folate reductase inhibitors: Trimethoprim*, Cotrimoxazole.

Sulfones: Dapsone*.

UNIT– V **7 Hours**

Introduction to Drug Design

Various approaches used indrug design.

Physicochemical parameters used in quantitative structure activity relationship (QSAR)such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques.

Combinatorial Chemistry: Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis

Text Books:

1. Wilsonand Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.

Reference Books

1. Burger's Medicinal Chemistry, VolItoIV.
2. Introduction to principles of drug design-Smithand Williams.
3. Remington's Pharmaceutical Sciences.

Web Links:

W1:**https://www.technoindiauniversity.ac.in/Pharmacy/syllabus_2024_25/B.pharma_sem 6. pdf**

W2https://www.slideshare.net/slideshow/antibiotics-history-nomenclatures-stereochemistry-sar/270896839

W3https://www.ncbi.nlm.nih.gov/books/NBK557666/

W4https://www.slideshare.net/slideshow/antifungal-agents-238422766/238422766

W5https://pharmdbm.com/medicinal-chemistry-3-unit-5-notes-semester-6/

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MEDICINAL CHEMISTRY-III (Practical)

SUBJECT CODE: 2513PY56

COURSE OBJECTIVE: Upon completion of the subject student shall be able to

COB1: Understand the importance of drug design and different techniques of drug design.

COB2: Understand the chemistry of drugs with respect to their biological activity.

COB3: Know the metabolism, adverse effects and therapeutic value of drugs.

COB4: Know the importance of SAR of drugs.

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

CO1 : Characterise the importance of drug design and different techniques of drug design.

CO2 : Elaborate the chemistry of drugs with respect to their biological activity.

CO3 : Justify the assay of imported drugs

CO4 : Describe the importance of SAR of drugs.

CO5 : Synthesis of the important compounds

CO6 : Explain Various approaches used in drug design and Pharmacophore modelling and docking techniques.

Mapping of Course Outcomes with Program Outcomes:

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

Course Content **4Hours/week**

List of Experiments:

Expt. No	Title	CO
1.	Preparation of drugs and intermediates	**CO1**
2.	Sulphanilamide	**CO1**
3.	7-Hydroxy, 4-methyl coumarin	**CO1**
4.	Chlorobutanol	**CO2**
5.	Triphenyl imidazole	**CO2**
6.	Tolbutamide	**CO3**
7.	Hexamine	**CO4**
8.	Assay of drugs	**CO4**
9.	Isonicotinic acid hydrazide	**CO5**
10.	Chloroquine	**CO5**
11.	Metronidazole	**CO5**
12	Dapsone	**CO5**
13.	Chlorpheniramine maleate	**CO5**
14	Benzyl penicillin	**CO6**
15	Preparation of medicinally important compounds or intermediates by Microwave irradiation technique	**CO6**

Text Books

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry

Reference Books:

1. Burger's Medicinal Chemistry, Vol I to IV.
2. Introduction to principles of drug design- Smith and Williams.
3. Remington's Pharmaceutical Sciences.

Web Links:

W1: https://www.jru.edu.in/studentcorner/lab-manual/bpharm/6th-sem/Medicinal%20Chemistry-III.pdf
W2: https://pharmacyinfoline.com/medicinal-chemistry-iii-practical/
W3: https://pharmacyinfoline.com/assay-isonicotinic-acid-hydrazide/
W4:https://mlrip.ac.in/wp-content/uploads/2022/03/MEDICINAL-CHEMISTRY-III-LAB-MANUAL.pdf
W5: https://www.studocu.com/in/document/andhra-university/b-pharmacy/medicinal-chemistry-iii-lab-manual/62449243

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PHARMACOLOGY- III (Theory)

SUBJECT CODE: 2513PY51

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

COB1: Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases.

COB2: Comprehend the principles of toxicology and treatment of various poisonings.

COB3: Appreciate correlation of pharmacology with related medical sciences.

COB4: Analyze the pharmacological actions of drugs acting on the respiratory and gastrointestinal systems, and understand their therapeutic roles.

COB5: Evaluate the pharmacological basis and clinical application of chemotherapeutic agents including antibacterial, antifungal, antiviral, antimalarial, and anticancer drugs.

COB6: Understand the concepts of immunopharmacology and chrono pharmacology, and their applications in optimizing therapeutic outcomes.

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

CO1: Describe the pharmacological management of Respiratory & Gastrointestinal problems.

CO2: Explain various infectious agents, mechanisms, sensitivity, and resistance of different anti-infective agents.

CO3: List the different antiviral drugs, antitubercular, antileprotics, antimalarial and antiamoebics.

CO4: Classify anticancer drugs, Immunosuppressants, drugs used to treat UTI & STD

CO5: Assess various types of toxicity studies, principles of treatment and management of various poisoned conditions.

CO6: Explain about chrono pharmacology and chronotherapy.

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	2
CO3	2	2
CO4	2	3
CO5	2	3
CO6	1	2

Course Content: **45 Hours**

UNIT-I **10hours**

1. Pharmacology of drugs acting on Respiratory system

a. Anti -asthmatic drugs

b. Drugs used in the management of COPD

c. Expectorants and antitussives

d. Nasal decongestants

e. Respiratory stimulants

2. Pharmacology of drugs acting on the Gastrointestinal Tract

a. Antiulcer agents.

b. Drugs for constipation and diarrhoea.

c. Appetite stimulants and suppressants.

d. Digestants and carminatives.

e. Emetics and anti-emetics.

UNIT-II **10hours**

3. Chemotherapy

a. General principles of chemotherapy.
b. Sulphonamides and cotrimoxazole.
c. Antibiotics-Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides

UNIT-III **10hours**

3. Chemotherapy

a. Antitubercular agents
b. Antileprotic agents
c. Antifungal agents
d. Antiviral drugs
e. Anthelmintics
f. Antimalarial drugs
g. Antiamoebic agents

UNIT-IV **08 hours**

3. Chemotherapy

a. Urinary tract infections and sexually transmitted diseases.
b. Chemotherapy of malignancy.

4. Immunopharmacology

a. Immunostimulants
b. Immunosuppressants

Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars

UNIT-V **07hours**

5. Principles of toxicology

a. Definition and basic knowledge of acute, subacute and chronic toxicity.
b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity
c. General principles of treatment of poisoning
d. Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning.

6. Chrono pharmacology

a. Definition of rhythm and cycles.
b. Biological clock and their significance leading to chronotherapy.

Text Books:

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier.

2. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.

Reference Books:

1. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill

2. Goodman and Gilman's, The Pharmacological Basis of Therapeutics

3. N.Udupa and P.D. Gupta, Concepts in Chronopharmacology.

Web Links:

W1: https://www.digimat.in/nptel/courses/medical/pharmacology/PH11.html

W2: **https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=eCJfy23Kjy3c0vICLa6VYg==**

W3: **https://www.mooc-list.com/categories/medicine-pharmacology**

W4: https://lms.innovesen.co.in/

W5: https://www.micromedexsolutions.com/micromedex2/librarian

L T P C

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PHARMACOLOGY-III (Practical)

Subject Code: 2513PY57

Course Objectives:

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

COB1: Accurately calculate doses required for pharmacological experiments, ensuring precision and safety in drug administration.

COB2: Evaluate antiallergic activity through mast cell stabilization assays, providing insights into mechanisms and potential therapeutic applications.

COB3: Study the anti-ulcer activity of drugs using both pylorus ligation (SHAY) rat models and NSAID-induced ulcer models, fostering a deeper understanding of gastrointestinal health and drug effects.

COB4: Analyze the pharmacological effects of drugs on gastrointestinal motility and organ-specific responses using in vitro and in vivo techniques.

COB5: Evaluate hypoglycemic activity, acute toxicity, and pyrogen testing to assess drug safety and efficacy using standard animal models and biochemical tools.

COB6: Apply basic biostatistical methods (t-test, ANOVA, Chi-square, Wilcoxon tests) to interpret experimental pharmacological data with scientific accuracy.

Course Outcomes:

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

CO1: Recall dose calculations in pharmacological experiments and to relate the antiallergic activity and anti-ulcer activity in animals

CO2: Demonstrate the effect of drugs on gastrointestinal motility and the agonistic/antagonistic effect on guinea pig ileum

CO3: Analyze serum biochemical parameters by using semi- autoanalyser

CO4: Determine the effect of saline purgative on frog intestine, hypoglycemic effect and test for pyrogens using Rabbits

CO5: Determine LD50, acute skin irritation & acute eye irritation

CO6: Predict the pharmacokinetic parameters and adapt the biostatistical methods in experimental pharmacology

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	2	-	-	1	1	2
CO2	3	-	2	1	2	2	-	-	1	1	2
CO3	3	-	2	1	2	2	-	-	1	1	2
CO4	3	-	2	1	2	2	-	-	1	1	2
CO5	3	-	2	1	2	2	-	-	1	1	2
CO6	3	-	2	1	2	2	-	-	1	1	2

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	3	2
CO6	3	2

Course Content **4Hours/week**

LIST OF EXPERIMENTS

Expt. No	Title	CO
1.	Dose calculation in pharmacological experiments	**CO1**
2.	Antiallergic activity by mast cell stabilization assay	**CO1**
3.	Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model	**CO1**
4.	Study of effect of drugs on gastrointestinal motility	**CO2**
5.	Effect of agonist and antagonists on guinea pig ileum	**CO2**
6.	Estimation of serum biochemical parameters by using semi- autoanalyzer	**CO3**
7.	Effect of saline purgative on frog intestine	**CO4**
8.	Insulin hypoglycaemic effect in rabbit	**CO4**
9.	Test for pyrogens (rabbit method)	**CO4**
10.	Determination of acute oral toxicity (LD50) of a drug from a given data	**CO5**
11.	Determination of acute skin irritation / corrosion of a test substance	**CO5**
12.	Determination of acute eye irritation / corrosion of a test substance	**CO5**
13.	Calculation of pharmacokinetic parameters from a given data	**CO6**
14.	Biostatistics methods in experimental pharmacology (student's t test, ANOVA)	**CO6**
15.	Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)	**CO6**

Text Books

1. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
2. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan

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.
3. Ian Kitchen. Textbook of in vitro practical pharmacology. Latest edition, Publisher: Black well Scientific.

Web Links:

W1: https://www.jru.edu.in/studentcorner/lab-manual/bpharm/4th-sem/Pharmacology%20-I.pdf?utm

W2: https://drnaitiktrivedi.com/wp-content/uploads/2022/09/7.-To-Study-of-effect-of-hepatic-microsomal-enzyme-inducers-on-the-phenobarbitone-sleeping.pdf?utm

W3: https://pharmacy.dypvp.edu.in/documents/ICT/Virtual-Labs/Pharmacology.pdf

W4: https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-bt36/?utm

W5: https://www.slideshare.net/slideshow/pharmacolgy-practicalpptx/249733018?utm

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HERBAL DRUG TECHNOLOGY (Theory)

Subject Code: 2513PY52
Course Objectives: Upon completion of the course, the student shall be able to
COB1: Understand basic principles of herbal drug industry.
COB2: Know WHO guidelines for herbal drugs.
COB3: Explain quality control, standardization, and GMP of herbal drugs.
COB4: Explore applications of herbal cosmetics and nutraceuticals.

Course Outcomes:
At the end of the course, the student will be able to:
CO1: Qualitative identification of extracts of crude drugs
CO2: Summarize the standard parameters of Ayurvedic preparations.
CO3: Summarize the standard parameters of herbal formulations.
CO4: Quantitative analysis of extracts of crude drugs.
CO5: Evaluate the crude drugs by monographic analysis
CO6: Design and formulate the herbal product preparations and evaluate them.

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	2	2
CO5	3	3
CO6	3	3

Course Content **45 Hours**

Herbs as raw materials **11 Hours**

Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs Selection, identification and authentication of herbal materials Processing of herbal raw material

Biodynamic Agriculture

Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.

Indian Systems of Medicine

a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy

b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika,Churna, Lehya and Bhasma.

UNIT-II

Nutraceuticals **7 Hours**

General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases.

Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification.

Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.

UNIT-III **10 Hours**

Herbal Cosmetics

Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.

Herbal excipients:

Herbal Excipients– Significance of substances of natural origin as excipients– colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes.

Herbal formulations : Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes

UNIT- IV **10Hours**

Evaluation of Drugs WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs.

Patenting and Regulatory requirements of natural products:

a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy

b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma &Neem.

Regulatory Issues- Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs- Schedule Zof Drugs & Cosmetics Act for ASU drugs.

UNIT-V **07 Hours**

General Introduction to Herbal Industry

Herbal drugs industry: Present scope and future prospects.

A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.

Schedule T– Good Manufacturing Practice of Indian systems of medicine

Components of GMP (Schedule– T) and its objectives
Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records

Text Books:

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady & Robber.

Reference Books:

1. Pharmacognosy & Phytochemistry by V.D.Rangari
2. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
3. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002

Web Links:

W1: https://globalresearchonline.net/journalcontents/v69-2/27.pdf
W2: https://www.albertscience.com/asset/images/uploads/15947339224222.pdf
W3: https://www.phdmsme.in/uploaded_files/project_report/1536151263_616.pdf
W4:https://ijcrt.org/papers/IJCRT2211482.pdf#:~:text=WHO%20provides%20guideline%20for%20herbal%20drug%20assessment%201%29,safety%20assessment%203%29%20Toxicity%20assessment%204%29%20Stability%20assessment.
W5: https://www.wbhealth.gov.in/ayush/download/ISM/Schedule-T.pdf

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HERBAL DRUG TECHNOLOGY (Practical)

SUBJECT CODE: 2513PY58

Course Objectives: Uponcompletion of this course the student should be able to:

COB1: Understand raw material as source of herbal drugs from cultivation to herbal drug product

COB2: know the WHO and ICH guidelines for evaluation ofherbal drugs

COB3: know the herbal cosmetics, natural sweeteners, nutraceuticals 4. appreciate patenting of herbal drugs, GMP.

Course Outcomes:

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

CO1: Describe the Qualitative identification of extracts of crude drugs

CO2: Summarize the standard parameters of Ayurvedic preparations

CO3: Summarize the standard parameters of herbal formulations.

CO4: Analyse the Quantitative analysis of extracts of crude drugs.

CO5: Evaluate the crude drugs by monographic analysis

CO6: Design and formulate the herbal product preparations and evaluate them.

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	2	3
CO4	3	2
CO5	3	3
CO6	2	3

LIST OF EXPERIMENTS **4 HRS/WEEK**

List of experiments:

Expt. No	Title	CO
1.	To perform preliminary phytochemical screening of crude drugs.	**CO1**
2.	Determination of the alcohol content of Asava and Arista	**CO2**
3.	Evaluation of excipients of natural origin	**CO3**
4.	Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.	**CO4**
5.	Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopeial requirements.	**CO4**
6.	Monograph analysis of herbal drugs from recent Pharmacopoeias	**CO5**
7.	Determination of Aldehyde content	**CO6**
8.	Determination of Phenol content	**CO6**
9.	Determination of total alkaloids	**CO6**

Text Books:

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady& Robber.

Reference Books:

1. Pharmacognosy & Phytochemistry by V.D.Rangari
2. Pharmacopeial standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
3. Mukherjee, P.W. Quality Controlof Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

Web Links:

W1: https://jiwaji.edu/pdf/ecourse/pharmaceutical/Evaluation%20of%20crude%20drugs.pdf

W2: https://www.pharmaacademias.com/evaluation-of-crude-drugs-principles-and-methods/

W3: https://pharmacyinfoline.com/herbal-drug-technology-practical/

W4:https://www.ijpsonline.com/articles/analytical-methods-for-standardization-of-ayurvedic-iasavasi-and-iaristasi-a-review.pdf

W5: https://ijprdjournal.com/myapp/uploads/73-1295-1322%20Dipali%20Dhumal.pdf

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BIOPHARMACEUTICS AND PHARMACOKINETICS (Theory)

Subject Code: 2513PY53

Course Objectives: Upon completion ofthis course the student should be able to:

COB1: Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.

COB2: Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.

COB3: To understand the concepts of bioavailability and bioequivalence of drugproducts and their significance and understand various pharmacokinetic parameters, their significance & applications.

Course Outcomes:

CO1: Describe about the concepts, factors and study models of absorption, distribution and protein binding.

CO2: Describe about the concepts, factors and study models of elimination.

CO3: Discuss about protocols of the bioavailability and bioequivalence studies.

CO4: Explain about the various pharmacokinetic models, assessment of parameters using one compartment model and their significance.

CO5: Explain about the two-compartment model, assessment of parameters and understand the calculation of loading dose, maintenance dose and describe the clinical setting.

CO6: Describe about the concepts of non-linear pharmacokinetics and assessment of parameters.

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	1	1	1	1	1	1	1
CO2	3	2	2	2	1	1	1	1	1	1	1
CO3	3	3	3	2	2	2	1	1	2	2	2
CO4	3	3	3	2	2	2	1	1	2	2	2
CO5	3	3	3	3	2	2	2	1	2	2	2
CO6	3	2	2	2	2	2	1	1	1	1	1

Mapping of Course Outcomes with Program Specific Outcomes

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

Course Content: **45 Hours**

Unit-I **10 Hours**

Introduction to Biopharmaceutics

Absorption; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes, **Distribution** Tissue permeability of drugs, binding of drugs, apparent, volumeof drug

distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs

Unit-II **10 Hours**

Elimination: Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs

Bioavailability and Bioequivalence: Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in- vitro-in-vivo* correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

Unit-III **10 Hours**

Pharmacokinetics: Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - K_E ,t1/2,Vd,AUC,Ka, Clt and CL_R- definitions methods of eliminations, understanding of their significance and application.

Unit-IV **8 Hours**

Multicompartment models: Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and mainetnance doses and their significance in clinical settings.

Unit-V **7 Hours**

Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing non-linearity.

C. Michaelis-menton method of estimating parameters, Explanation with example of drugs.

Textbooks:

1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.
2. Biopharmaceutics and Pharmacokinetics; By Robert F Notari

Reference Books:

1. Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition,Prentice-Hall Inernational edition.USA.
2. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal,Vallabh Prakashan Pitampura, Delhi.
3. Pharmacokinetics: ByMilo Glbaldi Donald, R. Mercel Dekker Inc.

Web links

W1:https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=WR+tSjp4YS3g7BIFEffOcw==

W2: https://www.drsubhashtech.edu.in/img/studymaterial/DSTC-1586861258.pdf

W3: https://www.ncbi.nlm.nih.gov/books/NBK557405/

W4:http://www.jiwaji.edu/pdf/ecourse/pharmaceutical/PROTEIN%20BINDING%20OF%20DRUGS.pdf

W5:https://www.nps.org.au/australian-prescriber/articles/pharmacokinetics-made-easy-9-non-linear-pharmacokinetics

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PHARMACEUTICAL BIOTECHNOLOGY

Course Code: 2513PY54

Course Objective: Upon completion of the course, the student shall be able to:
COB1: Understand the basic principles of biotechnology and their relevance to pharmaceutical sciences.
COB2: Gain knowledge on enzyme biotechnology and genetic engineering techniques used in drug development.
COB3: Comprehend the immune system, monoclonal antibodies, vaccines, and immunological reactions.
COB4: Learn advanced molecular biology techniques and their applications in microbial genetics and transformation.
COB5: Acquire practical knowledge of fermentation technology and the production and processing of pharmaceutical and biological products.

Course Outcomes: At the end of the course students will be able to
CO1: Describe the basics of biotechnology including genetic engineering, protein engineering, enzyme production, immobilization, and biosensors.
CO2: Summarize the concepts of genetic engineering, recombinant DNA technology, PCR, and the production of biotech products.
CO3: Classify elements of the immune system, hypersensitivity reactions, monoclonal antibodies, and vaccines.
CO4: Explain microbial genetics, microbial biotransformation, mutation, and immunological techniques.
CO5: Describe fermentation technology and the production of pharmaceutical products.
CO6: Discuss the collection, processing, and storage of blood products.

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	2	2	2	3
CO2	3	3	3	2	3	2	3	2	2	2	3
CO3	3	2	2	2	3	1	2	2	1	2	2
CO4	3	2	2	3	2	2	3	2	1	2	2
CO5	3	2	3	3	3	2	3	3	2	3	3
CO6	3	1	1	2	2	2	2	2	2	2	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **45 Hours**

Unit I **10 Hours**

a) Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.
b) Enzyme Biotechnology- Methods of enzyme immobilization and applications.
c) Biosensors- Working and applications of biosensors in Pharmaceutical Industries.
d) Brief introduction to Protein Engineering.
e) Use of microbes in industry. Production of Enzymes- General consideration- Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.
f) Basic principles of genetic engineering.

Unit – II **10 Hours**

a) Study of cloning vectors, restriction endonucleases and DNA ligase.
b) Recombinant DNA technology. Application of genetic engineering in medicine.
c) Application of r DNA technology and genetic engineering in the production of:
i) Interferon **ii)** Vaccines- hepatitis- B **iii)** Hormones-Insulin.
d) Brief introduction to PCR.

Unit – III **10 Hours**

Types of immunity- humoral immunity, cellular immunity
a) Structure of Immunoglobulin's.
b) Structure and Function of MHC.
c) Hypersensitivity reactions, Immune stimulation and Immune suppressions.
d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.
e) Storage conditions and stability of official vaccines
f) Hybridoma technology- Production, Purification and Applications
g) Blood products and Plasma Substitutes.

Unit IV **08 Hours**

a) Immune blotting techniques- ELISA, Western blotting, Southern blotting.
b) Genetic organization of Eukaryotes and Prokaryotes
c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.
d) Introduction to Microbial biotransformation and applications.
e) Mutation: Types of mutation/mutants.

Unit V **07 Hours**

a) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.
b) Large scale production fermenter design and its various controls.
c) Study of the production of - penicillin, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,
d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substitutes.

Text Books:

1. Essentials of Pharmaceutical Biotechnology by S.P. Vyas and V.K. Dixit, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
2. Biotechnology by B.D. Singh, Kalyani Publishers, New Delhi.

Reference Books:

1. Molecular Biotechnology: Principles and Applications of Recombinant DNA – B.R. Glick and J.J. Pasternak.
2. Kuby Immunology – R.A. Goldshy *et al.*
3. Molecular Biology and Biotechnology – J.M. Walker and E.B. Gingold.

Web Links:

W1: https://www.pharmaguideline.com/2020/10/enzyme-immobilization-methods-applications.html
W2: https://www.genome.gov/genetics-glossary/Recombinant-DNA
W3: https://www.ncbi.nlm.nih.gov/books/NBK10757/
W4: https://www.labome.com/method/Western-Blotting.html
W5: https://microbiologynote.com/fermentation-technology-principle-types-process/

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PHARMACEUTICAL QUALITY ASSURANCE (Theory)

Subject Code: 2513PY55

Course Objectives: Upon completion of the subject student shall be

COB1: Understand the cGMP aspects in the Pharmaceutical Industry
COB2: Remember the scope of quality certifications
COB3: Create organization and personnel responsibilities
COB4: Evaluate & Support the QC Tests and Complaints
COB5: Enumerate the GLP

Course Outcomes:

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

CO1: Enumerate Quality Assurance and Quality Management concepts, TQM.

CO2: Explain Quality by design, ICH Guidelines, ISO 9000 ISO14000 and NABL accreditation.

CO3: Relation of Organization and personnel, Premises, Equipment's and raw materials

CO4: Apply Good Laboratory Practices and Warehousing Good warehousing practice, materials management.

CO5: Recommend quality Control test for containers, rubber closures and secondary packing materials. Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.

CO6: Design of Calibration and Validation-general principles of calibration, qualification and validation, importance and scope of validation.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **45 Hours**

UNIT-I **10 Hours**

Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP

Total Quality Management (TQM): Definition, elements, philosophies

Quality by design (QbD): Definition, overview, elements of QbD program, tools

ICH Guidelines: Purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines

ISO 9000 & ISO14000: Overview, Benefits, Elements, steps for registration

NABL accreditation: Principles and procedures.

UNIT-II **10 Hours**

Organization and personnel: Personnel responsibilities, training, hygiene and personal records.

Premises: Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.

Equipment's and raw materials: Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.

Warehousing: Good warehousing practice, materials management.

UNIT-III **10 Hours**

Quality Control: Quality Control test for containers, rubber closures and secondary packing materials.

Good Laboratory Practices: General provisions, organisation and personnel, facilities, Equipment, testing facilities operations, test and control articles, protocol for conduct of a non-clinical laboratory study, records and reports, disqualification of testing facilities.

UNIT -IV **08 Hours**

Complaints: Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.

Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.

UNIT -V **07Hours**

Calibration and Validation: Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation.

Warehousing: Good warehousing practice, materials management.

Text Books

1. Quality Assurance and Quality management in pharmaceutical industry, 2nd edition, Y. Anjaneyulu, R.Marayya, Pharmamed Press.
2. Pharmaceutical Quality Assurance, B.P.Nagori,Ajay,Gaur,Renu Solanki,Vipin Mathur, latest edition.

Reference Books:

1. Quality Assurance guide by organisation of pharmaceutical products of India.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol.69.
3. How to practice GMPs -P P Sharma.

Web links:

1:https://www.ich.org/page/ich-guidelines

2:https://www.iso.org/obp/ui/#iso:std:iso:9000:ed-4:v1:en

3:https://tdr.who.int/publications/m/item/2001-01-01-handbook-good-laboratory-practice

4:https://www.fda.gov/media/161201/download

5:https://nabl-india.org/

SEMESTER VII

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INSTRUMENTAL METHOD OF ANALYSIS (THEORY)

SUBJECT CODE: 2513PY59

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

COB1: Understand the interaction of matter with electromagnetic radiations and its applications in drug.

COB2: Understand the chromatographic separation and analysis of drugs.

COB3: Perform quantitative & qualitative analysis of drugs using various analytical instruments.

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

CO1: Demonstrate and **explain** about UV - Visible Spectroscopy and Fluorimetry along with its applications.
CO2: Describe about Infra-red Spectroscopy, Flame Photometry along with its applications.
CO3: Determine about Atomic Absorption Spectroscopy and Nepheloturbidometry along with its applications.
CO4: Classify about Types of Chromatography like Column and Paper.

CO5: Develop the techniques of TLC and Electrophoresis.

CO6: Recommend the Principles, Instrumentation & Applications of Gas Chromatography, and High-Performance Liquid Chromatography, Ion – Exchange Chromatography, Gel and Affinity Chromatography.

Mapping of Course Outcomes with Program Outcomes

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **45 HOURS**

UNIT-I **10 Hours**

UV Visible Spectroscopy

Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations.

Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode.

Applications - Spectrophotometric titrations, Single component and multi component analysis.

Fluorimetry - Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, Instrumentation and applications.

UNIT-II **10 Hours**

IR Spectroscopy - Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations.

Instrumentation - Sources of radiation, wavelength selectors, and detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications.

Flame Photometry - Principle, interferences, instrumentation and applications.

Atomic Absorption Spectroscopy- Principle, interferences, instrumentation and applications.

Nephelo Turbidometry- Principle, instrumentation and applications.

UNIT-III **10 Hours**

Introduction to Chromatography

Adsorption and Partition Column Chromatography - Methodology, advantages, disadvantages and applications.

Thin Layer Chromatography- Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications.

Paper Chromatography - Introduction, methodology, development techniques, advantages, disadvantages and applications.

Electrophoresis – Introduction, factors affecting electrophoretic mobility, Techniques of paper, Gel, capillary electrophoresis, applications.

UNIT- IV **08 Hours**

Gas Chromatography - Introduction, theory, instrumentation, Derivatization, temperature programming, advantages, disadvantages and application.

High Performance Liquid Chromatography (HPLC) - Introduction, theory, instrumentation, advantages and applications.

UNIT-V **07 Hours**

Ion Exchange Chromatography - Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications

Gel Chromatography - Introduction, theory, Instrumentation and applications.

Affinity Chromatography - Introduction, Theory, Instrumentation and applications.

TEXT BOOKS:

1] Instrumental Methods of Chemical Analysis by B.K Sharma.

2] Instrumental Methods of chemical Analysis by G. R. Chatwal & K. Anand.

REFERENCES:

1] Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake.

2] Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel.

3] Organic spectroscopy by Y.R. Sharma.

WEB LINKS:

W1: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2742920/

W2: https://iopscience.iop.org/article/10.1088/1748-0221/13/06/P06007/meta

W3: https://journals.sagepub.com/home/jns

W4: https://www.scitechnol.com/journal-chromatography-research.php

W5: https://www.mdpi.com/journal/chromatography

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INSTRUMENTAL METHOD OF ANALYSIS (PRACTICAL)

SUBJECT CODE: 2513PY63

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

COB1: Understand the interaction of matter with electromagnetic radiations and its applications in drug.

COB2: Understand the chromatographic separation and analysis of drugs.

COB3: Perform quantitative & qualitative analysis of drugs using various analytical Instruments.

COURSE OUTCOMES: At the end of the course, student will be able to
CO1: State the Calibration of UV – Visible Spectrophotometer.
CO2: Determination of Absorption Maxima of Potassium Permanganate and effect of solvent on absorption spectrum of Phenol using UV – Visible Spectrophotometer.
CO3: Calculation of the Quality and Quantity of the various drug substances by using UV – Visible Spectrophotometer.
CO4: Evaluation of Quality and Quantity of the various drug substances by using Fluorimetry, Nephelometry and Flame Photometry.
CO5: Characterization and Separation of Amino acids and sugars by various techniques of chromatography like Column, Paper and TLC.
CO6: Demonstration on HPLC and GC.

Mapping of Course Outcomes with Program Outcomes

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content: **4 Hours/Week**

LIST OF EXPERIMENTS

Expt. No	Title	CO
1.	Calibration of UV – Visible Spectrophotometer.	CO1
2	Determination of Absorption Maxima of Potassium Permanganate	CO2
3	Effect of Solvent on Absorption Spectrum of Phenol using UV – Visible Spectrophotometer.	CO2
4	Assay of Paracetamol by using Specific Absorbance value.	CO3
5	Assay of Paracetamol by Chemical Derivatization Method.	CO3
6	Estimation of Salicylic Acid by Calibration Curve Method.	CO3
7	Estimation of Sulphanilamide eye drops by Colorimetry.	CO3
8	Estimation of Quinine Sulphate by Fluorimetry.	CO4
9	Estimation of Sulphates by Nephelometry.	CO4
10	Determination of Sodium Ion Concentration in unknown sample by Flame Photometry.	CO4
11	Determination of Potassium Ion Concentration in unknown sample by Flame Photometry.	CO4
12	Separation and Identification of amino acids by using Ascending paper chromatography.	CO5
13	Separation and Identification of amino acids by using Radial paper chromatography.	CO5
14	Preparation of Thin Layer Chromatographic Plates.	CO5
15	Separation and Identification of Sugars by using Thin Layer Chromatography.	CO5
16	Separation and Identification of Plant Pigments by Column chromatography.	CO5
17	Demo on HPLC.	CO6
18	Demo on Gas Chromatography.	CO6

TEXT BOOKS:

1] Instrumental Methods of Chemical Analysis by B.K Sharma.

2] Instrumental Methods of chemical Analysis by G. R. Chatwal & K. Anand.

REFERENCES:

1] Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake.

2] Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel.

3] Organic spectroscopy by Y.R. Sharma.

4] Text book of Pharmaceutical Analysis by Kenneth A. Connors.

WEB LINKS:

W1: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2742920/

W2: https://iopscience.iop.org/article/10.1088/1748-0221/13/06/P06007/meta

W3: https://journals.sagepub.com/home/jns

W4: https://www.scitechnol.com/journal-chromatography-research.php

W5: https://www.mdpi.com/journal/chromatography

L	T	P	C
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INDUSTRIAL PHARMACY-II (Theory)

SUBJECT CODE: 2513PY60
Course Objectives: Upon completion of the course the student shall be able to
COB1: Know the process of pilot plant and scale up of pharmaceutical dosage
COB2: Understand the process of technology transfer from lab scale to commercial batch
COB3: Know different Laws and Acts that regulate pharmaceutical industry
COB4: Understand the approval process and regulatory requirements for drug product

Course Outcomes: At the end of the course, the student will be able to:
CO1: Identify various concept of Pilot plant general considerations, scale up considerations for solids, liquid orals, semi solids, SUPAC guidelines, platform technology
CO2: Demonstrate the guidelines for Technology Transfer, Commercialization - practical aspects, Technology Transfer agencies, MoUs.
CO3: Assess historical overview, Role & responsibilities of Regulatory Affairs & Regulatory authorities
CO4: Explain the bio-equivalence studies and data submission for FDA
CO5: Discuss various key concepts to develop Quality management & Certifications and Quality by Designs.
CO6: Explain the Indian Regulatory requirements.

Mapping of Course Outcomes with Program Outcomes:

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

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	3	3

COURSE CONTENTS **45 HOURS**

UNIT I **10Hours**

Pilot plant scales up techniques: General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology

UNIT II **10 Hours**

Technology development and transfer: WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipment's, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal issues

UNIT III **10 Hours**

Regulatory affairs: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals Regulatory requirements for drug approval: Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies

UNIT IV **08 Hours**.

Quality management systems: Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP

UNIT V **07 Hours**

Indian Regulatory Requirements: Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.

Text books:

1. Douglas J Pisano and David S. Mantu's. Text book of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition.

2. Theory and Practice of Industrial Pharmacy By Lachmann and Liberman

References

1. Pharmaceutical Preformulations; By J.J.Wells.
2. Applied production and operations management; By Evans, Anderson, Sweeney and Williams.
3. Modern Pharmaceutics; By Gillbert and S Banker.

Weblinks:

W1. review-on-pilot-plant-scale-up-techniques-used-in-solid-liquid-and-semisolids.pdf

W2. International Regulatory Affairs Updates, 2005. available at http://www.iraup.com/about.php

W3. Chapter 16: Innovation, technology development and transfer

W4. Quality Management System - an overview | ScienceDirect Topics

L T P C

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PHARMACY PRACTICE (Theory)

SUBJECTCODE: 2513PY61

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

COB1. know various drug distribution methods in a hospital

COB 2. appreciate the pharmacy stores management and inventory control

COB 3. monitor drug therapy of patient through medication chart review and clinical review

COB 4. obtain medication history interview and counsel the patients

COB 5. identify drug related problems

COB 6. detect and assess adverse drug reactions

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

CO1: Describe Hospital organization and detect and assess adverse drug reactions, reporting and its management.

CO2: Explain various drug distribution methods system in the hospital, and monitor drug therapy of patient, role pharmacist in medication adherence and community pharmacy management.

CO3: Explain how to obtain medication history interview, Pharmacy and Therapeutic committee, information services, counselling.

CO4: Explain Education and training program in the hospital, Prescribed medication order and communication skills.

CO5: Describe medication of management, budget preparation and its implementation, and also help in rational use of common over the counter medication.

CO6: Explain pharmacy stores and inventory control management and able to interpret selected laboratory results of specific disease states and controlling of investigational use of drug.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program-Specific Outcomes:

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

Course Content: **45 Hours**

Unit I: **10 Hours**

a. Hospital and it's organization:

Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non- clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions.

b. Hospital pharmacy and its organization:

Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.

c. Adverse drug reaction :

Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management.

d. Community Pharmacy :

Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store.

Unit II: **10Hours**

a. Drug distribution system in a hospital:

Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs.

b. Hospital formulary:

Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary.

c. Therapeutic drug monitoring :

Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring.

d. Medication adherence:

Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence.

e. Patient medication history interview:

Need for the patient medication history interview, medication interview forms.

f. Community pharmacy management :

Financial, materials, staff, and infrastructure requirements.

Unit III: 10Hours

a. Pharmacy and therapeutic committee :

Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation.

b. Drug information service :

151 Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information.

c. Patient counseling :

Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist

d. Education and training program in the hospital :

Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education.

e. Prescribed medication order and communication skills :

Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients.

Unit IV 8 Hours

a. Budget preparation and implementation :

Budget preparation and implementation

b. Clinical Pharmacy :

Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care.

c. Over the counter (OTC) sales

Introduction and sale of over the counter, and Rational use of common over the counter medications.

Unit-V 7 Hours

a. Drug store management and inventory control :

Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure

b. Investigational use of drugs :

152 Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.

c. Interpretation of Clinical Laboratory Tests:

Blood chemistry, hematology, and urinalysis.

Text Books:

1. Basic skills in interpreting laboratory data – Scott LT, American Society of Health System
Pharmacists Inc.
2. Practice Standards and Definitions - The Society of Hospital Pharmacists of Australia.1997

Reference Books:

1. Biopharmaceutics and Applied Pharmacokinetics - Leon Shargel, Prentice Hall Publication
2. Relevant review articles from recent medical and pharmaceutical literature.
3. Clinical Pharmacokinetics - Rowland and Tozer, Williams and Wilkins Publication.

Web Links:

W1:https://www.pharmaacademias.com/hospital-pharmacy-and-its-organization/
W2:https://www.medindia.net/health/drugs/therapeutic-drug-monitoring.htm
W3:https://www.firsthope.co.in/education-and-training-program-in-the-hospital#google_vignette
W4:https://courseware.cutm.ac.in/wp-content/uploads/2020/06/Education-and-Training-Prog.pdf
W5:https://www.pharmacy.uobasrah.edu.iq/images/stage_five/Applied_Therapeutics_I/dr_ali_mohammed_hadi/Interpretation%20of%20Clinical%20Laboratory%20Tests.pdf

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NOVEL DRUG DELIVERY SYSTEM (Theory)

Course Code: 2513PY62
Course Objective: At the end of the course students will be able to
COB1: To understand various approaches for development of novel drug delivery systems.
COB2: To apply the criteria for selection of drugs and polymers in novel formulations
COB3: To formulate and evaluate Novel drug delivery systems effectively.

Course Outcomes:

CO1: Describe the Concepts various approaches for development of novel drug delivery systems. Know various polymers used in formulation of controlled release drug delivery systems.
CO2: Summarize the salient features of methods of microencapsulation, formulation considerations of buccal delivery systems, implants and osmotic pumps.
CO3: Explain the importance of formulation approaches of Transdermal Drug Delivery Systems, Gastro retentive drug delivery systems, Naso pulmonary drug delivery system.
CO4: Classify and explain approaches and applications of liposome's, noisome, nanoparticles etc.
CO5: Describe the salient features of methods to Overcome Preliminary study, ocular formulations and ousters.
CO6: Development of intra uterine devices (IUDs) and applications.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes

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

Course Content: **45 Hours**

Unit-I **10 Hours**

Controlled drug delivery systems: Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles.
Physicochemical and biological properties of drugs relevant to controlled release Formulations. **Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.

Unit-II **10 Hours**
Microencapsulation: Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications.
Mucosal Drug Delivery system: Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems.
Implantable Drug Delivery Systems: Introduction, advantages and disadvantages, concept of implants and osmotic pump.

Unit-III **10 Hours**
Transdermal Drug Delivery Systems: Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches.

Gastroretentive drug delivery systems: Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high-density systems, inflatable and gastroadhesive systems and their applications

Naso pulmonary drug delivery system: Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays,
nebulizers.

Unit-IV **08 Hours**
Targeted drug Delivery: Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications.

Unit-V **07 Hours**
Ocular Drug Delivery Systems: Introduction, intra ocular barriers and methods to overcome – Preliminary study, ocular formulations and ocuserts.
Intrauterine Drug Delivery Systems: Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications

Text Books:
1. Controlled Drug Delivery by Suresh P .Vyas and Roop k Khar
2. Novel Drug Delivery System by N K Jain

References:

1. Y W. Chien, Novel Drug DeliverySystems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.

Web Links:

W1: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8512302/
W2: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3093624/
W3: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6523542/
W4: https://biomaterialsres.biomedcentral.com/articles/10.1186/s40824-021-00226-6
W5: https://ijppr.humanjournals.com/wp-content/uploads/2023/06/21.Vishnupriya-B-V-Prasobh- G-R-Varsha-V-R-Shabin-P-Panchamy-Nair-K.pdf

SEMESTER VIII

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BIOSTATISTICS AND RESEARCH METHODOLOGY (Theory)

SUBJECT CODE: 2513PY65

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

COB1: Understand and apply basic statistical measures like correlation, mean, median, mode, range, and standard deviation in biostatistics contexts.

COB2: Utilize advanced statistical methods applicable to pharmacy, including regression analysis, probability theory, sampling techniques, and parametric/non-parametric tests.

COB3: Develop proficiency in designing and conducting experiments, especially in clinical trials and observational/experimental studies, to contribute effectively to pharmaceutical research.

Course outcomes:

CO1: Discuss the applications of Biostatics such as Correlation, Mean, Median, Mode, Range and standard deviation.

CO2: Discuss the applications of Biostatics in Pharmacy such as Regression, Probability-theory, Sampling technique, Parametric tests and Non Parametric tests

CO3: Apprehend the design of experiments for Phases of clinical trials and observational and experimental studies.

CO4: Accomplish the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of experiment).

CO5: Accomplish the statistical techniques in Design of experiments.

CO6: Explain the statistical techniques in analysis of experiments.

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	3
CO2	3	3
CO3	3	2
CO4	2	3
CO5	3	2
CO6	2	2

Course contents **45 Hours**

Unit-I **10 Hours**

a. Introduction: Statistics and Biostatistics, Frequency Distribution
b. Measures ofCentral Tendency: Mean, Median, Mode -Pharmaceutical Examples
c. Measures of Dispersion: Dispersion, Range, Standard Deviation - Pharmaceutical Problems
d. Correlation: Definition, Karl Pearson's Coefficient of Correlation, Multiple Correlation-Pharmaceuticals Examples

Unit-II: **10 Hours**

a. Regression: Curve Fitting by the Method of Least Squares, Fitting the lines y= a + bx and x = a
+ by, Multiple Regression, Standard Error of Regression with Pharmaceutical Examples

b. Probability: Definition of Probability, Binomial Distribution, Normal Distribution, Poisson's Distribution, Properties with Problems
c. Sample, Population, Large Sample, Small Sample
d. Null Hypothesis, Alternative Hypothesis, Sampling, Essence of Sampling, Types of Sampling, Error – I type, Error-II type, Standard Error of Mean (SEM) with Pharmaceutical Examples
e. Parametric Tests: t-test, ANOVA, Least Significance Difference

Unit-III: **10 Hours**

a. Non-Parametric Tests: Wilcoxon Rank SumTest, Mann-Whitney U Test, Kruskal-Wallis Test, Friedman Test

b. Introduction to Research: Need for Research, Need for Design of Experiments, Experiential DesignTechnique, Plagiarism
c. Graphs: Histogram, Pie Chart, Cubic Graph, Response Surface Plot, Counter Plot Graph
d. Designing the Methodology: Sample Size Determination and Power of a Study, Report Writing and Presentation of Data, Protocol, Cohort Studies, Observational Studies, Experimental Studies, Designing Clinical Trial, Various Phases

Unit-IV: **8 Hours**

a. Blocking and Confounding System for Two-Level Factorials
b. Regression Modeling: Hypothesis Testing in Simple and Multiple Regression Models
c. Introductionto Practical Components ofIndustrial and Clinical Trials Problems
d. Statistical Analysis Using Excel, SPSS, MINITAB, DESIGN OF EXPERIMENTS, R- Online Statistical Software's to Industrial and Clinicaltrial approach

Unit-V: **7 Hours**

a. Factorial Design (Definition, 2^2, 2^3 design, Advantage ofFactorial Design)
b. Response Surface Methodology: Central Composite Design, Historical Design, Optimization Techniques.

Text Books:

1. Designand Analysis ofExperiments –PHI Learning Private Limited, R. Pannerselvam,
2. Designand Analysis ofExperiments – Wiley Students Edition, Douglas and C. Montgom

Reference Books:

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork.
2. Fundamentalof Statistics – Himalaya Publishing House- S.C.Guptha

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/

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SOCIAL AND PREVENTIVE PHARMACY (Theory)

SUBJECT CODE: 2513PY66

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

COB1: Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.
COB2: Have a critical way of thinking based on current healthcare development.
COB3: Evaluate alternative ways of solving problems related to health and pharmaceutical issues

Course Outcomes:

CO1: Explain the concepts of health and diseases, Social and health education, Health and hygiene.
CO2: Discuss about Prevention and control of diseases.
CO3: Discuss about National health programs for HIV AND AIDS, TB, Integrated disease surveillance program (IDSP) & leprosy.
CO4: Discuss about mental health, deafness, Universal immunization programme, blindness, Pulse polio programme.
CO5: Demonstrate about National health intervention programs for mother and child, family welfare, tobacco control, Malaria Prevention Programmes.
CO6: Discuss about Community services and Functions of PHC, Improvement in rural, urban sanitation, Health promotion and education in school.

Mapping of course outcomes with program outcomes

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course contents **45 HOURS**

UNIT I: **10 Hours**

Concept of health and disease: Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick.
Social and health education: Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention.
Sociology and health: Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health
Hygiene and health: personal hygiene and health care; avoidable habits

UNIT II: **10 Hours**

Preventive medicine: General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse

UNIT III: **10 Hours**
National health programs, its objectives, functioning and outcome of the following:
HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, National programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme

UNIT IV: **08 Hours**
National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program

UNIT V: **07 Hours**

Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.

Textbooks

1. Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, ISBN: 9789380704104, JAYPEE Publications
2. Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Saha Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEE Publications

References

1. Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications
2. Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2nd Edition, 2012, ISBN: 9789350250440, JAYPEE Publications
3. Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN- 14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS.

Weblinks

W1:https://aiimsrishikesh.edu.in/newwebsite/wpcontent/uploads/2018/09/768_Concept_of_health_and_disease.pdf
W2: https://www.acpm.org/about-acpm/what-is-preventive-medicine/
W3: https://naco.gov.in/nacp
W4:https://www.firsthope.co.in/national-health-intervention-programme-for-mother-child-principal-objectives-components-key-acti
W5:https://www.scribd.com/document/727811526/Community-Services-in-Rural-Urban-School-Health

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PHARMA MARKETING MANAGEMENT (Theory)

Subject Code: 2513PY67

Course Objective: Upon completion of the course, the student shall be ableto
COB1: Develop a comprehensive understanding of marketing principles, consumer behaviour, and market analysis, with specific emphasis on the pharmaceutical industry.
COB2: Provide in-depth knowledge of product decision-making, including product lifecycle management, branding, and portfolio analysis, tailored to pharmaceutical products.
COB3: Equip students with the skills to design effective promotional strategies, manage pharmaceutical marketing channels, and implement pricing strategies while addressing regulatory frameworks like DPCO and NPPA.

Course Outcomes:
CO1: Define the fundamental concepts of marketing and differentiate between marketing and selling in the context of the pharmaceutical industry.
CO2: Explain the components of the pharmaceutical market, including market segmentation, consumer profiles, and prescribing behaviours.
CO3: Apply knowledge of product decisions such as product lifecycle management, branding and packaging to develop strategies for pharmaceutical products.
CO4: Analyse promotional strategies, including advertising, personal selling, and online techniques, to enhance pharmaceutical product outreach.
CO5: Evaluate the design and management of pharmaceutical marketing channels, including conflict resolution and physical distribution tasks.
CO6: Design pricing strategies and address challenges in price management, considering regulatory frameworks like DPCO and NPPA, and emerging marketing concepts.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course contents **45 Hours**

Unit I **10 Hours**

Marketing: Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; analyzing consumer buying behavior; industrial buying behavior.

Pharmaceutical market: Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation& targeting.Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist.Analyzing the Market;Role of market research.

Unit II **10 Hours**

Product decision: Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.

Unit III **10 Hours**

Promotion: Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.

Unit IV **08 Hours**

Pharmaceutical marketing channels: Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.

Professional sales representative (PSR): Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.

Unit V **07 Hours**

Pricing: Meaning, importance, objectives, and determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority).

Emerging concepts in marketing: Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.

Text books:

1. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India
2. Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition)

Reference Books:

1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi.
2. Walker, Boyd and Larreche: Marketing Strategy- Planning and Implementation, Tata MC GrawHill, New Delhi.
3. Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill.

Web Links:

W1: https://njppp.com/fulltext/28-1300808964.pdf
W2:https://www.happiestminds.com/wp-content/uploads/2020/12/Product-Lifecycle-in-Pharmaceutical-Industry-Journey-of-Drug-from-Ideation-to-commercialization.pdf
W3: https://pharma-dept.gov.in/dpconppa
W4:https://pharmadept.gov.in/sites/default/files/UCPMP%202024%20for%20website.pdf
W5:https://www.slideshare.net/slideshow/professional-sales-representative-psrpptx/267721007

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PHARMA REGULATORY SCIENCE (Theory)

Subject Code: 2513PY68

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

COB1: Know about the process of drug discovery and development

COB2: Understand the regularatory authorities governing the manufacture and sale t he pharmace- uticals.

COB3: Know the regulatory approval process and their registration in Indian and international markets.

COB4: Learn clinical trial protocol development

COB5: Understand Pharmacovigilance and safety monitoring

Course Outcomes:

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

CO1: Analyse the stages of drug discovery and development, including pre-clinical and clinical studies.

CO2: Explain the regulatory approval processes and timelines for IND, NDA, and ANDA applications in various regions

CO3: Demonstrate the procedures for exporting pharmaceutical products, including technical documentation and drug registration requirements

CO4: Develop clinical trial protocols and outline the roles and responsibilities of investigators, sponsors, and monitors in clinical trials

CO5: Evaluate pharmacovigilance practices and the importance of safety monitoring in clinical trials

CO6: Enumerate basic regulatory concepts, terminologies, and the importance of regulatory documents such as the Orange Book and Purple Book

Mapping of Course Outcomes with Program Outcomes:

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

Course Content **45 Hours**

UNIT-I **10 hours**

New Drug Discovery and development

Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development**.**

UNIT-II **10 Hours**

Regulatory Approval Process

Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA.

Regulatory authorities and agencies

Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)

UNIT-III **10 Hours**

Registration of Indian drug product in overseas market

Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical Document (eCTD),

ASEAN Common Technical Document (ACTD) research.

UNIT-IV **08 Hours**

Clinical trials

Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee-formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials.

UNIT-V **07 Hours**

Regulatory Concepts

Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book

Text Books:

1. Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.
2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences, Vol.185. Informa Health care Publishers.

Reference Books:

1. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences, Vol.190.
2. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons. Inc.
3. FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics/edited by Douglas J. Pisano, David Mantus.

Web Links:

W1: https://www.frontiersin.org/journals/drug-discovery/articles/10.3389/fddsv.2023.1201419/full

W2:https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-_science/drug-approval

W3:https://www.researchgate.net/publication/353603391_Regulatory_Requirement_and_Step_for_Registration_and_Approval_of_Indian_Drug_Products_in_Overseas_Market

W4: https://www.who.int/health-topics/clinical-trials

W5: https://pharmacyinfoline.com/basic-terminology-pharmaceutical-regulatory-science/

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PHARMACOVIGILANCE (Theory)

Subject Code: 2513PY69

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

COB1: To provide a comprehensive understanding of the science and activities related to the detection, assessment, understanding, and prevention of adverse effects or any drug-related problems.

COB2: To familiarize with the methods and practices used in monitoring drug safety and the regulatory requirements for Pharmacovigilance.

COB3: To recognize the significance of Adverse Drug Reactions (ADRs) and their impact on public health

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

CO1: Describe the principles and importance of Pharmacovigilance in ensuring the safety and efficacy of medications

CO2: Classify Adverse Drug Reactions (ADRs) and **explain** their mechanisms and management strategies.

CO3: Demonstrate the ability to report ADRs using standard guidelines and tools, such as CDSCO forms and WHO forms

CO4: Analyze Pharmacovigilance data to identify trends and patterns that contribute to improving drug safety

CO5: Evaluate the role of national and international regulatory authorities in Pharmacovigilance and their frameworks

CO6: Collaborate in the design and **implement** Pharmacovigilance programs in healthcare settings.

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	3
CO2	2	3
CO3	2	3
CO4	3	3
CO5	3	3
CO6	2	3

Course Content **45 Hours**

Unit I **7 hours**

Introduction to Pharmacovigilance

- History and Development of Pharmacovigilance
- Importance of Safety Monitoring of Medicine
- WHO International Drug Monitoring Programme
- Pharmacovigilance Program of India (PvPI)

Introduction to adverse drug reactions

- Definitions and classification of ADRs
- Detection and reporting
- Methods in Causality Assessment
- Severity and seriousness assessment
- Predictability and preventability assessment
- Management of adverse drug reactions

Basic terminologies used in Pharmacovigilance

- Terminologies of adverse medication-related events
- Regulatory terminologies

Unit II **10 Hours**

Drug and disease classification

- Anatomical, therapeutic and chemical classification of drugs
- International classification of diseases
- Daily defined doses
- International Non-proprietary Names for Drugs

Drug dictionaries and coding in Pharmacovigilance

- WHO adverse reaction terminologies
- MedDRA and Standardized MedDRA queries
- WHO drug dictionary
- Eudravigilance medicinal product dictionary

Information resources in Pharmacovigilance

- Basic drug information resources
- Specialized resources for ADRs

Establishing Pharmacovigilance programme

- Establishing in a hospital
- Establishment & operation of a drug safety department in industry
- Contract Research Organizations (CROs)

Unit III **10 Hours**

Vaccine safety surveillance

- Vaccine Pharmacovigilance
- Vaccination failure
- Adverse events following immunization

Pharmacovigilance methods

- Passive surveillance – Spontaneous reports and case series
- Stimulated reporting
- Active surveillance – Sentinel sites, drug event monitoring and registries

- Comparative observational studies – Cross-sectional study, case-control study and cohort study
- Targeted Clinical Investigations

Communication in Pharmacovigilance

- Effective communication in Pharmacovigilance
- Communication in Drug Safety Crisis Management
- Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media

Unit IV **8 Hours**

Safety data generation

- Pre-clinical phase
- Clinical phase

Post-approval phase (PMS)

- ICH Guidelines for Pharmacovigilance
- Organization and objectives of ICH
- Expedited reporting
- Individual case safety reports
- Periodic safety update reports
- Post-approval expedited reporting
- Pharmacovigilance planning
- Good clinical practice in Pharmacovigilance studies

Unit V **7 Hours**

Pharmacogenomics of adverse drug reactions

- Genetics-related ADR with example focusing PK parameters**. Drug safety evaluation in special population**
- Pediatrics
- Pregnancy and lactation
- Geriatrics

CIOMS

- CIOMS Working Group
- CIOMS Form

CDSCO (India) and Pharmacovigilance

- D&C Act and Schedule Y
- Differences in Indian and global Pharmacovigilance requirements

Text Books:

1. Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers.
2. Practical Drug Safety from A to Z by Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.

Reference Books:

1. Mann's Pharmacovigilance: Elizabeth B. Andrews, Nicholas, Wiley Publishers.
2. Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, Wiley Publishers.
3. An Introduction to Pharmacovigilance: Patrick Waller, Wiley Publishers.

Web Links:
W1: https://who-umc.org/media/1703/24747.pdf
W2: https://www.pharmaacademias.com/drug-and-disease-classification/
W3: https://www.pharmaacademias.com/international-nonproprietary-names/
W4:https://www.igntu.ac.in/eContent/IGNTU-eContent-676428845806-B.Pharma-8-Dr.KunjbihariSulakhiya-Pharmacovigilance-3.pdf
W5: https://pmc.ncbi.nlm.nih.gov/articles/PMC8120428/

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QUALITY CONTROL AND STANDARDIZATION OF HERBALS (Theory)

Subject Code: 2513PY70
Course Objectives: Upon completion of the course, the student shall be able to
COB1: Know WHO guidelines for quality control of herbal drug
COB2: know Quality assurance in herbal drug industry
COB3: know the regulatory approval process and their registration in Indian and international markets , EU and ICH guidelines for quality control of herbal drugs

Course Outcomes:
At the end of the course, the student will be able to:
CO1: **Recall** the basic tests for drugs, pharmaceutical substances, and medicinal plant materials.
CO2: **Comprehend** the WHO guidelines for quality control of herbal drugs and medicinal plants.
CO3: **Analyze** the quality assurance parameters in the herbal drug industry, including cGMP, GAP, and GLP
CO4: **Apply** EU and ICH guidelines for quality control of herbal drugs in research and development.
CO5: **Synthesize** information to design stability testing protocols for herbal medicines.
CO6: **Evaluate** the regulatory requirements for herbal medicines, including pharmacovigilance and pharmacopoeias.

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	3
CO4	2	3
CO5	2	3
CO6	3	3

Course Content **45 HOURS**

UNIT-I **10 Hours**

Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms WHO guidelines for quality control of herbal drugs.
Evaluation of commercial crude drugs intended

UNIT-II **10 Hours**

Quality assurance in herbal drug industry of cGMP, GAP, GMP and GLP in traditional system of medicine.
WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants.

UNIT-III **10 Hours**

EU and ICH guidelines for quality control of herbal drugs.
Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines

UNIT- IV **08 Hours**

Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products.
Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions.

UNIT-V **07 Hours**

Regulatory requirements for herbal medicines. WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems Comparison of various Herbal Pharmacopoeias.
Role of chemical and biological markers in standardization of herbal products

Text Books:

1. "Herbal Drug Technology" by S.S. Aggrawal (2002) - Covers herbal drug technology and application.
2. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals" by P.W. Mukherjee (2002) - Focuses on quality control aspects of herbal drugs.

Reference Books:

1. W.C.Evans, Trease and Evans Pharmacognosy, 16thedition, W.B. Sounders & Co., London, 2009.
2. Quality Control Methods for Medicinal Plant Materials" by WHO (1998) - Provides WHO guidelines on quality control methods.

Web Links:

W1: https://iris.who.int/bitstream/handle/10665/43034/9241592214_eng.pdf?
W2: https://pmc.ncbi.nlm.nih.gov/articles/PMC11703424/?utm_
W3:https://ijprajournal.com/issue_dcp/A%20Review%20on%20Research%20Guidelines%20for%20Evaluation%20of%20Safety%20and%20Efficacy%20of%20Herbal%20Medicine.pdf
W4: https://www.gmp-compliance.org/files/guidemgr/2011_EMA_Quality_Herbal_Guideline.pdf
W5:https://www.gmp-publishing.com/content/en/gmp-news/news-about-gmp-cgmp/d/ema-final-guideline-on-quality-of-herbal-products?utm

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COMPUTER AIDED DRUG DESIGN (Theory)

Subject Code: 2513PY71

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

COB1: To understand the stages of drug discovery and development, including lead identification, bioisosterism , and analog-based drug design.

COB2: To explore the principles of SAR, QSAR, and molecular modeling techniques for virtual screening and drug optimization.

COB3: To apply bioinformatics and chemoinformatics tools, along with molecular mechanics and quantum mechanics, for efficient drug design and analysis.

Course Outcomes

CO1: Understand the stages of drug discovery and development, including rational and serendipitous approaches to lead discovery.

CO2: Apply knowledge of bioisosterism and its classification to perform analog- based drug design, including case study analysis.

CO3: Analyze the relationship between SAR and QSAR, and evaluate physicochemical parameters using experimental and theoretical methods.

CO4: Develop skills in molecular modeling techniques, including pharmacophore mapping, virtual screening, and docking-based screening.

CO5: Design new drug candidates using de novo drug design methods, leveraging ADME and biochemical databases.

CO6: Evaluate molecular mechanics and quantum mechanics principles for energy minimization and conformational analysis in drug design.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes

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

Course contents 45 Hours

UNIT-I **10 Hours**

Introduction to Drug Discovery and Development Stages of drug discovery and development Lead discovery and Analog Based Drug Design Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation. Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Any three case studies

UNIT-II **10 Hours**

Quantitative Structure Activity Relationship (QSAR) SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

UNIT-III **10 Hours**

Molecular Modeling and virtual screening techniques Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening, Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening. De novo drug design.

UNIT-IV **08 Hours**

Informatics & Methods in drug design Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.

UNIT-V **07 Hours**

Molecular Modeling: Introduction to molecular mechanics and quantum mechanics.Energy Minimization methods and Conformational Analysis, global conformational minima determination.

Textbooks

Patrick, Graham L. *An Introduction to Medicinal Chemistry*, 6th Edition, Oxford University Press.

Silverman, Richard B. *The Organic Chemistry of Drug Design and Drug Action*, 2nd Edition, Academic Press.

Reference Books

Delgado, J.N. and Remers, W.A. *Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry*, 12th Edition, Lippincott Williams & Wilkins.

Martin, Y.C. *Quantitative Drug Design*, Marcel Dekker, New York.

Smith, H.J. and Williams, H. *Introduction to the Principles of Drug Design*, 3rd Edition, CRC Press.

Web Links

W1 https://www.drugbank.caa
W2 https://pubchem.ncbi.nlm.nih.govv
W3 https://www.rcsb.orgg
W4 https://www.swissadme.chh
W5 https://www.molinspiration.comm

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CELL AND MOLECULAR BIOLOGY

Course Code: 2513PY72

Course Objective: Upon completion of the course, the student shall be able to:
COB1: Understand the structural organization and function of cells and their organelles.
COB2: Learn the fundamental molecular mechanisms involved in gene expression and regulation.
COB3: Explore the dynamics of cellular signaling and communication.
COB4: Understand molecular biology techniques used in research and industry.
COB5: Comprehend cell cycle control, apoptosis, and implications in cancer biology.

Course Outcomes (CO's): At the end of the course students will be able to
CO1: Describe cell structure, types, and organelle functions.
CO2: Explain DNA replication, transcription, and translation mechanisms.
CO3: Illustrate gene regulation in prokaryotic and eukaryotic cells.
CO4: Apply knowledge of molecular techniques in diagnostics and therapeutics.
CO5: Evaluate signaling pathways and their role in health and disease.
CO6: Analyse cell cycle regulation and its implications in cancer progression.

Mapping of Course Outcomes with Program Outcomes:

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

Course Content **45 Hours**

UNIT-I **10 Hours**

a. Cell and Molecular Biology: Definitions theory and basics and applications.
b. Cell and Molecular Biology: History and Summation.
c. Properties of cells and cell membrane.

d. Prokaryotic versus Eukaryotic
e. Cellular Reproduction
f. Chemical Foundations – an Introduction and Reactions (Types)

UNIT-II **10 Hours**

a. DNA and the Flow of Molecular Information
b. DNA Functioning
c. DNA and RNA
d. Types of RNA
e. Transcription and Translation

UNIT-III **10Hours**

a. Proteins: Defined **and** Amino Acids
b. Protein Structure
c. Regularities in Protein Pathways
d. Cellular Processes
e. Positive Control and significance of Protein Synthesis

UNIT- IV **08 Hours**

a. Science of Genetics
b. Transgenic and Genomic Analysis
c. Cell Cycle analysis
d. Mitosis and Meiosis
e. Cellular Activities and Checkpoints

UNIT-V **07 Hours**

a. Cell Signals: Introduction
b. Receptors for Cell Signals
c. Signaling Pathways: Overview
d. Misregulation of Signaling Pathways
e. Protein-Kinases: Functioning

Text Books:

1. Bruce Alberts et al., Molecular Biology of the Cell, Garland Science.
2. Lodish et al., Molecular Cell Biology, W.H. Freeman.
3. Harvey Lodish, Cell and Molecular Biology, W.H. Freeman.

Reference Books:

1. Ananthanarayan and Paniker, Textbook of Microbiology, Orient Longman.
2. N.K. Jain, Pharmaceutical Microbiology, Vallabh Prakashan.
3. Edward Alcamo, Fundamentals of Microbiology, Jones & Bartlett Learning.

Web Links:

W1: NCBI Bookshelf – Molecular Biology of the Cell
W2: Nature Reviews Molecular Cell Biology
W3: https://learn.genetics.utah.edu/
W4: https://www.genome.jp/kegg/pathway.html
W5: Protocols.io – Molecular Biology Protocols

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Cosmetic Science (Theory)

Subject Code: 2513PY73

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

COB1: Understand what cosmetics are, their types, and how they work on skin, hair, and oral areas.

COB2: Learn the basic ingredients and steps to prepare skincare, haircare, and oral care products.

COB3: Explore how sun protection works, the use of natural herbs in cosmetics, and basic testing methods.

COB4: Gain knowledge of how cosmetic products are checked for effectiveness using simple equipment.

COB5: Identify common beauty and hygiene problems and know how cosmetics help manage them.

Course Outcomes:

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

CO1: Identify the key ingredients used in cosmetics and cosmeceuticals.

CO2: List out various formulations of cosmetics and cosmeceuticals.

CO3: Determine current technologies in the market for selection and developing cosmetics and cosmeceuticals.

CO4: Categorize key ingredients and basic science to develop cosmetics and cosmeceuticals.

CO5: Construct Scientific knowledge to develop cosmetics and cosmeceuticals.

CO6: Discuss the desired Safety, stability, and efficacy of cosmetics and cosmeceuticals.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course Content **45 Hours**

UNIT I **10 Hours**

Classification of cosmetic and cosmeceutical products

Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs

Cosmetic excipients: Surfactants, rheology modifiers, humectants, emollients, preservatives. Classification and application

Skin: Basic structure and function of skin.

Hair: Basic structure of hair. Hair growth cycle.

Oral Cavity: Common problem associated with teeth and gums**.**

UNIT II **10 Hours**

Principles of formulation and building blocks of skin care products:

Face wash,

Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmecuticals.

Antiperspants & deodorants- Actives & mechanism of action.

Principles of formulation and building blocks of Hair care products:

Conditioning shampoo, Hair conditioner,anti-dandruff shampoo.

Hair oils.

Chemistry and formulation of Para-phylene diamine based hair dye.

Principles of formulation and building blocks of oral care products:

Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.

UNIT III **10 Hours**

Sun protection, Classification of Sunscreens and SPF.

Role of herbs in cosmetics:

Skin Care: Aloe and turmeric

Hair care: Henna and amla.

Oral care: Neem and clove

Analytical cosmetics: BIS specification and analytical methods for shampoo, skin-cream and toothpaste**.**

UNIT IV **08 Hours**.

Principles of Cosmetic Evaluation: Principles of submeter, craniometer. Measurement of TEWL, Skin Colour, Hair tensile strength, Hair combing properties Soaps and syndet bars. Evolution and skin benefits.

UNIT V **07 Hours**

Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis.

Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes

Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor.

Antiperspirants and Deodorants- Actives and mechanism of action

Text Books

1. Cosmetics – Formulations, Manufacturing and Quality Control, P.P. Sharma, 4 th Edition, Vandana Publications Pvt. Ltd., Delhi.
2. Text book of cosmelicology by Sanju Nanda & Roop K. Khar, Tata Publishers.

Reference Books:

1. Andre O. Barel - Handbook of Cosmetic Science and Technology 3rd ed.
2. Harry's Cosmeticology, Volumes I-II eight edition.
3. Dr. Kamla Pathak & Dr. Ankur Vaidya Cosmetic Science Concepts and Principles published by Nirali Prakashan publications.

Web Links:

W1: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2887514/
W2: https://gyansanchay.csjmu.ac.in/wp-content/uploads/2022/04/hair-coloring.pdf
W3: https://www.science.org/doi/pdf/10.1126/science.78.2018.192
W4: https://www.scielo.br/j/abd/a/8XDWfBdfgbXckLqgFg8SgXR/abstract/?lang=en
W5: https://www.derm.theclinics.com/article/S0733-8635(05)70384-3/fulltext

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PHARMACOLOGICAL SCREENING METHODS (Theory)

SUBJECT CODE: 2513PY74

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

COB1: Appreciate the applications of various commonly used laboratory animals.

COB2: Appreciate and demonstrate the various screening methods used in preclinical research

COB3: Appreciate and demonstrate the importance of biostatistics and research methodology

COB4: Design and execute a research hypothesis independently

Course Outcomes:

CO1 Recall the applications of commonly used laboratory animals.
CO2 Understand various screening methods used in preclinical research.
CO3 Apply ethical and regulatory guidelines in laboratory animal research.
CO4 Analyze research data using biostatistical tools.
CO5 Evaluate scientific literature to design research hypotheses.
CO6 Create research findings for presentation and publication.

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	2	3
CO2	3	3
CO3	3	2
CO4	2	3
CO5	3	2
CO6	2	2

Course Content: **45 Hours**

UNIT I: Laboratory Animals: **10 Hours**

Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration

in laboratory animals, Techniques of blood collection and euthanasia.

UNIT II: Preclinical screening models **10 Hours**

Introduction: Dose selection, calculation and conversions, Preparation of drug solution/suspensions, grouping of animals and Importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. Study of screening animal models for Diuretics, Nootropics, anti-Parkinson's, antiasthmatics, Preclinical screening models: for CNS activity- analgesic, Antipyretic, anti-inflammatory, general anesthetics, sedative and Hypnotics, antipsychotic, antidepressant, antiepileptic, Ant parkinsonism, Alzheimer's disease

UNIT III: Preclinical screening models: for ANS activity, **10 Hours**

Sympathomimetics, Sympatholytic Parasympathomimetic Parasympatholytic, Skeletal muscle relaxants, Drugs acting on eye, local anesthetics

UNIT IV: Preclinical screening models: **08 Hours**

Preclinical screening models: for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslepidemic, anti aggregatory, coagulants, and anticoagulants Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.

UNIT V: Research methodology and Bio-statistics **07 Hours**

Selection of research topic, review of literature, research hypothesis and study design Pre-clinical data analysis and interpretation using Students 't' test and One-way ANOVA. Graphical representation of data.

References:

1. Fundamentals of experimental Pharmacology-by M.N. Ghosh
2. Hand book of Experimental Pharmacology-S.K. Kulakarni
3. CPCSEA guidelines for laboratory animal facility.

Text Books:

1. Drug discovery and Evaluation by Vogel H.G.
2. Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta
3. Introduction to biostatistics and research methods by PSS Sundar Rao and J. Richard

Web links:

W1 **https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=eCJfy23Kjy3c0vICLaa6VYg==**
W2 https://lms.innovesen.co.in/
W3 https://www.micromedexsolutions.com/micromedex2/librarian
W4 https://www.drugs.com/

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ADVANCED INSTRUMENTATION TECHNIQUES (Theory)

Subject Code: 2513PY75

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

COB1: Understand the advanced instruments used and its applications in drug analysis.

COB2: Understand the chromatographic separation and analysis of drugs.

COB3: Understand the calibration of various analytical Instruments, analysis of drugs using various analytical Instruments.

Course Outcomes:

CO1: Describe about Nuclear Magnetic Resonance Spectroscopy and Mass Spectroscopy along with its applications.

CO2: State about Introduction, Principle, Theory, Instrumentation and Thermal Method of Analysis.

CO3: Explain about X – Ray Diffraction Methods – origin of X- Rays and its concept, crystallography along with its applications.

CO4: Summarize about Calibration and Validation as per ICH and USFDA guidelines.

CO5: Choose the calibration of Instruments like Electronic balance, UV – Visible Spectrophotometer, IR, Fluorimeter, Flame Photometer, HPLC and GC.

CO6: Classify about and types of Radio Immuno Assays and Extraction Techniques, Hyphenated Techniques like LC – MS/MS, GC – MS/MS, HPTLC – MS/MS.

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
CO2	3	3	2	2	-	2	-	-	-	-	2
CO3	3	3	2	2	-	2	-	-	-	-	2
CO4	3	3	2	2	-	2	-	-	-	-	2
CO5	3	3	2	2	-	2	-	-	-	-	2
CO6	3	3	2	2	-	2	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course contents **45 HOURS**

UNIT-I **10 Hours**

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications.

MASS SPECTROMETRY - Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers -Time of flight and Quadrupole, instrumentation, applications.

UNIT-II **10 Hours**

THERMAL METHODS OF ANALYSIS: Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry.

RAY DIFFRACTION METHODS: Origin of X-rays, basic aspects of crystals, X - ray Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications.

UNIT-III **10 Hours**

CALIBRATION AND VALIDATION - as per ICH and USFDA guidelines

CALIBRATION OF FOLLOWING INSTRUMENTS

Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, Fluorimeter, Flame Photometer, HPLC and GC.

UNIT- IV **08 Hours**

RADIO IMMUNE ASSAY: Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno Assay.

EXTRACTION TECHNIQUES: General principle and procedure involved in the solid phase extraction and liquid-liquid extraction.

UNIT-V **07 Hours**

HYPHENATED TECHNIQUES - LC-MS/MS, GC-MS/MS, HPTLC-MS.

TEXT BOOKS:

1. Instrumental Methods of Chemical Analysis by B.K Sharma..
2. Instrumental Methods of chemical Analysis by G. R. Chatwal & K. Anand.
3. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel.

REFERENCE TEXT BOOKS:

1. Textbook of Instrumental Analysis, G.R. Anand Chatwal.
2. Textbook of Instrumental Analysis, Skoog

WEBLINKS:

W1: https://www.sciforce.org/index.php/JAMS
W2: https://www.intertek.com/analysis/dsc/
W3:https://www.fda.gov/files/drugs/published/Analytical-Procedures-and-Methods-Validation-for-Drugs-and- Biologics.pdf
W4: https://saspublishers.com/media/articles/SAJP-66263-272.pdf
W5:https://medicallabnotes.com/radioimmunoassay-ria-introduction-principle-test-requirements-procedure-result-interpreation-application-and-keynotes

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DIETARY SUPPLEMENTS AND NUTRACEUTICALS (THEORY)

Course Code: 2513PY76

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

COB 1: Understand the need of supplements by the different group of people to maintain Healthy life.

COB 2: Understand the outcome of deficiencies in dietary supplements.

COB 3: Appreciate the components in dietary supplements and the application.

COB 4: Appreciate the components in dietary supplements and the application.

COB 5: Appreciate the regulatory and commercial aspects of dietary supplements including Health claims.

Course Outcomes (CO's): At the end of the course students will be able to

CO1: Explanation regarding definitions of Functional foods, Nutraceuticals and Dietary supplements, Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals, Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community, Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of some compounds.

CO2: Illustration Phytochemicals as nutraceuticals: Occurrence and characteristic features of Carotenoids, Sulfides and Polyphenolics with examples.

CO3: Elaboration regarding Phytochemicals as nutraceuticals: Occurrence and characteristic features of Flavonoids, Prebiotics / Probiotics, Phyto estrogens, Tocopherols, Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods.

CO4: Classify Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, carbohydrates, nucleic acids, Dietary fibres and complex carbohydrates as functional food ingredients

CO5: Assess about Free radicals in some diseased conditions, Free radicals theory of ageing, Antioxidants, Synthetic antioxidants, Functional foods for chronic disease prevention.

CO6: Relate Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals, Regulatory Aspects, Pharmacopoeial Specifications for dietary supplements and nutraceuticals.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Course contents **45 HOURS**

UNIT-I

a. Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc.
b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community.
c. Source, Name of marker compounds and their chemical nature, Medicinal uses and Health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds.

UNIT-II

Phytochemicals as nutraceuticals: Occurrence and characteristic features (chemical nature Medicinal benefits) of following
a) Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, leutin
b) Sulfides: Diallyl sulfides, Allyl trisulfide.
c) Polyphenolics: Reservetrol
d) Flavonoids- Rutin, Naringin, Quercitin, Anthocyanidins, catechins, Flavones
e) Prebiotics / Probiotics: Fructo oligosaccharides, Lacto bacillum
f) Phyto estrogens: Isoflavones, daidzein, Geebustin, lignans
g) Tocopherols
h) Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, Wheat bran, rice bran, sea foods, coffee, tea and the like.

UNIT-III

a) Introduction to free radicals: Free radicals, reactive oxygen species, production of free Radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids.
b) Dietary fibres and complex carbohydrates as functional food ingredients.

UNIT-IV

a) Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney

damage, Muscle damage. Free radicals involvement in other disorders. Free radicals theory of Ageing.

b) Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α- Lipoic acid, melatonin

Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole.

c) Functional foods for chronic disease prevention

UNIT-V

a) Effect of processing, storage and interactions of various environmental factors on the Potential of nutraceuticals.

b) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods.

c) Pharmacopoeial Specifications for dietary supplements and nutraceuticals.

TEXT BOOKS:

1. Advanced Nutritional Therapies by Cooper. K.A., (1996).
2. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition) P.Faizal: BS Punblication.

REFERENCE BOOKS:

1. G. Gibson and C.williams Editors *2000 Functional foods* Woodhead Publ.Co.London.
2. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988).
3. Dietetics by Sri Lakshmi

WEB LINKS:

W1: https://dhsprogram.com/pubs/pdf/FR106/09Chapter09.pdf

W2: https://pmc.ncbi.nlm.nih.gov/articles/PMC8434187/

W3: https://www.physio-pedia.com/Free_Radicals

W4: https://www.antiox.org/index.php/fra

W5: https://www.sciencedirect.com/science/article/pii/B9780124103962000177

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PHARMACEUTICAL PRODUCT DEVELOPMENT (Theory)

Subject Code: 2513PY77

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

COB1: To understand the pharmaceutical product development manufacturing, quality tests performed and excipients in the pharmaceutical product development.

COB2: To explore the Optimization techniques in pharmaceutical product development.

COB3: Optimization by factorial designs and QbD and its applications in pharmaceutical product development.

COB4: To evaluate the regulatory considerations for pharmaceutical product development.

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

CO1: Understand.to understand the pharmaceutical product development manufacturing and quality tests performed.

CO2: Apply knowledge of excipients in the pharmaceutical product development

CO3: Apply knowledge of excipients in the pharmaceutical product development for the advanced formulations.

CO4: Develop the Optimization techniques in pharmaceutical product development.

CO5: Design. Optimization by factorial designs and QbD and its applications in pharmaceutical product development

CO6: Evaluate- to evaluate the regulatory considerations for pharmaceutical product development.

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	3	3
CO2	3	3
CO3	3	3
CO4	3	2
CO5	3	2
CO6	3	3

Course contents **45HOURS**

Unit-I **10Hours**

Introduction to pharmaceutical product development, objectives, regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms.

Unit-II **10Hours**

An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Solvents and solubilizers ii. Cyclodextrins and their applications iii. Non - ionic surfactants and their applications iv. Polyethylene glycols and sorbitol's v. Suspending and emulsifying agents vi. Semi solid excipients.

Unit-III **10Hours**

An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Tablet and capsule excipients ii. Directly compressible vehicles iii. Coat materials iv. Excipients in parenteral and aerosols products v. Excipients for formulation of NDDS Selection and application of excipients in pharmaceutical formulations with specific industrial applications.

Unit-IV **08Hours**

Optimization techniques in pharmaceutical product development. A study of various optimization techniques for pharmaceutical product development with specific examples. Optimization by factorial designs and their applications. A study of QbD and its application in pharmaceutical product development.

Unit-V **07Hours**

Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations.

Text books:

1. Pharmaceutical Statistics Practical and Clinical Applications by Stanford Bolton, CharlesBon; Marcel Dekker Inc.
2. Encyclopedia of Pharmaceutical Technology, edited by James swarbrick, Third Edition, Informa Healthcare publishers.

Reference books:

1. The Theory and Practice of Industrial Pharmacy, Fourth Edition, edited by Roop kKhar, S P Vyas, Farhan J Ahmad, Gaurav K Jain; CBS Publishers and Distributors Pvt.Ltd. 2013.
2. Martin's Physical Pharmacy and Pharmaceutical Sciences, Fifth Edition, edited by Patrick J. Sinko, BI Publications Pvt. Ltd.

Weblinks:

1. **Pharmaceutical Excipients: Functions, Selection Criteria, and Emerging Trends – International Journal of Pharmaceutical Investigation**
2. **1725099998.pdf**
3. **(PDF) Overview of new product development strategies and models**
4. **Understanding Pharmaceutical Quality by Design - PMC**
5. **(PDF) Review of Optimization Techniques**