

## **1. Vision and Mission of the Department**

**VISION-**Lead the future of global healthcare and well-being of the communities we serve.

**MISSION-**The Department of Pharmacy is committed to:

**1. Education:** Provide the most comprehensive and highest quality education for pharmaceutical sciences in a learning environment that embraces diversity, equity, integrity, ethics, moral courage and accountability.

**2. Community service:** Conduct health education programs to the community to prevent disease and improve public health and well-ness by fostering an environment that promotes the safe, efficacious, and cost-effective use of medications.

**3. Research:** Develop a passion for discovery and innovations with multidisciplinary collaborative research and engage in creative partnerships locally and globally to advance health education, research, and practice.

**4. Entrepreneurship:** Encourage and support resourcefulness, originality, imagination, ingenuity, and vision in our students, faculty, and staff. Foster the development of entrepreneurs who have the ability to dream, inspire and innovate and courage to envisage the commercial success and socio economic productivity of innovations.

## **2. Program Educational Objectives (PEOs)**

<b>S.No</b>	<b>PROGRAMME EDUCATION OBJECTIVES (PEOs)</b>
1	To produce pharmacist workforce competent for the society.
2	To produce pharmacy graduates with employable skills and high technical competence in pharmaceutical industry and health care sectors
3	To inculcate research activity and develop passion for discovery and innovations
4	To develop entrepreneurship qualities that support growth of pharmaceutical intellectual property and contribute for economic development throughout the world.

### 3. Program Outcomes(POs)

S.No	PROGRAMME OUTCOME (PO)
1 <b>Pharmacy Knowledge</b>	Provide basic knowledge for understanding the principles and their applications in the area of Pharmaceutical Sciences and Technology.
2 <b>Technical Skills</b>	Develop an ability to use various instrument and equipment with an in depth knowledge on standard operating procedures for the same.
3 <b>Modern tool usage</b>	Develop/apply appropriate techniques, resources, and IT tools including prediction and modeling to complex health issues and medicine effect with an understanding of the limitations.
4 <b>Research and Development</b>	To demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of Pharmaceutical Sciences and Technology.
5 <b>Lifelong Learning</b>	Develop an aptitude for continuous learning and professional development with ability to engage in pharmacy practice and health education programs.
6 <b>Communication</b>	Communicate effectively on health care activities with the medical community and with society at large, to comprehend drug regulations, write health reports and provide drug information.
7 <b>The Pharmacist and Society</b>	Apply reasoning informed by the contextual knowledge to comprehend medical prescription, perform patient counselling and issue or receive clear instructions on drug safety and the consequent responsibilities relevant to the professional pharmacy practice.
8 <b>Ethics</b>	Follow the code of ethics and commit to professional values and responsibilities and norms of the pharmacy practice.
PSO 1 <b>Pharmaceutical product development</b>	To apply the knowledge of manufacturing, formulation and quality control of various pharmaceutical and cosmetic products in the form of powders, tablets, capsules, parenteral, solutions, suspensions, emulsions, creams, lotions and aerosols etc.
PSO 2 <b>Invention and Entrepreneurship</b>	Find the application of modern tools to integrate health care systems, design an effective product with commercial advantage and societal benefit, perform risk analysis and become entrepreneur.

#### 4. Mapping of PEOs and POs

	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	√	√			
PO2		√	√		
PO3		√		√	
PO4			√	√	
PO5	√				√
PO6	√				√
PO7		√			√
PO8					
PSO1		√	√		
PSO2			√	√	

## **5. Academic Regulations**

### **Short Title and Commencement**

These regulations shall be called as “The Regulations for the B. Pharm. Degree Program (CBCS) of the K L College of Pharmacy, K L University, Vaddeswaram, Andhra Pradesh, India. They shall come into effect from the Academic Year 2016-17. The regulations framed are subject to modifications from time to time by K L University to comply with the rules and regulations of Pharmacy Council of India (PCI), the statutory body for the Pharmacy Course in India.

### **2. Minimum qualification for admission**

#### **2.1 First year B. Pharm:**

Candidate shall have passed 10+2 examination conducted by the respective state/central government authorities recognized as equivalent to 10+2 examination by the Association of Indian Universities (AIU) with English as one of the subjects and Physics, Chemistry, Mathematics (P.C.M) and or Biology (P.C.B / P.C.M.B.) as optional subjects individually. Any other qualification approved by the Pharmacy Council of India as equivalent to any of the above examinations.

#### **2.2. B. Pharm lateral entry (to third semester):**

A pass in D. Pharm. course from an institution approved by the Pharmacy Council of India under section 12 of the Pharmacy Act.

### **3. Duration of the program**

The course of study for B.Pharm shall extend over a period of eight semesters (four academic years) and six semesters (three academic years) for lateral entry students. The curricula and syllabi for the program shall be prescribed from time to time by K L University in harmony with Pharmacy Council of India, New Delhi.

### **4. Medium of instruction and examinations**

Medium of instruction and examination shall be in English.

### **5. Attendance and progress**

In every course, student has to maintain a minimum of 75% attendance to be eligible for appearing in Semester end examination of the course, for cases of medical issues and other unavoidable circumstances the students will be condoned if their attendance is between 65% to 75% in every course, subjected to submission of medical certificates, medical case file and other needful documents to the concerned departments. However in case of a student having less than 65% attendance in any course, S/He shall be detained in the course and in no case such process will be relaxed.

There are no specific marks attached to attendance as such, however if the course coordinator of a course desires to award certain marks, for attendance in a course She/He can do so based on following guidelines, which thereby must be clearly reflected in respective course handouts, well before the commencement of the course work for such courses, which must be duly approved by the Dean Academic: For any course, not more than 5% marks can be allotted for attendance.

The distribution of marks is as follows:

95 to 100%	:	5marks
90 to 95%	:	4marks
85 to 90%	:	3marks
80 to 85%	:	2marks
75 to 80%	:	1marksBelow

75% (even in case of condonation "0"marks)

The marks, if allotted for attendance will have to be considered for all L-T-P components of a course cumulatively but not specifically for theory component for any course, however if the course is an elective, then the marks are for only theory owing to the L-T-P structure for such course being "X"-0-0.

## **6. Evaluationprocess**

A student's academic progress is examined through one or more of the following methods as decided by the Course Coordinator and duly approved by the Dean, Academic.

- Assignment
- Quiz
- Sessional
- ProjectReport
- Review
- Seminar
- GroupDiscussion
- In Class Participation / ActiveLearning
- Case StudyReport
- Capstone DesignProject
- Simulation
- ComprehensiveExam

- a) The Sessional tests and the Semester-End Examinations will be conducted as per the AcademicCalendar.
- b) As per the necessity, the Supplementary examinations will be conducted at the discretion of ViceChancellor.
- c) Students may have to take more than one examination in a day either during Semester End Examinations /Supplementaryexamination.

### **6.1. In-Semester Evaluation:**

- a) The process of evaluation should be continuous throughout the semester and involves components as listed in section 6.0.
- b) The maximum distribution of marks for In-Semester evaluation must not exceed **40%** of aggregate marks of the course.
- c) The distribution of weightage for various evaluation components will be decided and notified by the course coordinator through the course handout after approval by the Dean Academic, at the beginning of the semester.
- d) In order to maintain transparency in evaluation, answer scripts will be shown to the students for verification, within one week of conduct of exam. If there is any discrepancy in evaluation, the student can request the course coordinator to re-evaluate.
- e) The solution key and scheme of evaluation for all examinations will be displayed in the appropriate web portal of the course, within 2 days after the conduct of examination, by the course coordinator.
- f) No correction is permitted once the course coordinator submits the marks/grades to the Controller of Examination.
- g) In case the student is unable to appear for any such examination owing to medical grounds, participation in extra/ co curricular activities representing University/ state/ country; make up examination may be conducted as per the discretion of the Director / Principal of concerned College/school.

### **6.2. Semester end examination**

- a) The minimum weightage for Semester End Examination is **60%** of the aggregate marks in the ratio of credits allotted for Lecture (L) +Tutorial (T) to Practical(P).
- b) The pattern and duration of such examination will be decided and notified by the Course Coordinator through the Course handout, after approval from the Dean Academic.
- c) In order to maintain transparency in evaluation, answer scripts will be shown to the students for verification upon request. If there is any discrepancy in evaluation, the student can request the course coordinator to re-evaluate.

### Schemes for internal external assessments semester wise

Continuous assessment in theory					Sem End Assessment	Total Marks
Mid sem	Attendance	Active learning/Assignment	Internal Lab	Total		
22.5	5	5	7.5	40	60	100

### 6.3.Detentionpolicy

- a) In any course, a student has to maintain a minimum of 75% attendance and must secure a minimum of 40% marks in In-Semester Examinations to be eligible for appearing to the Semester End Examination, failing to fulfill these conditions will deem such student to have been detained in thatcourse.
- b) However the following are the special cases where the lack of attendance can becondoned:
  - i. Up to a maximum of 10% on medical grounds, in which case the student must submit the medical certificate from any recognized medicalpractitioner.
  - ii. Up to a maximum of 10% if the student represents the University / State / Countryin any Extra / Co-curricularactivities.
  - iii. The maximum extent to which a student can be condoned is 10%, and anystudent with less than 65% is deemed to bedetained.

### 6.4. Reports/Grades

#### 6.4.1. GradingProcess

- a) At the end of all evaluation components based on the performance of the student, each student is awarded based on ***absolute grading system***. The list of absolute grades and its connotation are givenbelow:

GRADE	GRADE POINTS	RANGE	
O (Outstanding)	10	85	100
A+(Excellent)	9	80	<85
A(Very Good)	8	65	<80
B+(Good)	7	60	<65
B(Above Average)	6	50	<60
C(Average)	5	45	<50
P (Pass)	4	40	<45
F(Fail)	0	<40	-
Ab (Absent)	0	-	-



- b) The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses and the sum of the number of credits of all the courses undergone by a student, in a semester.

$$\text{i.e. SGPA } (S_i) = \sum (C_i \times G_i) / \sum C_i$$

where ' $C_i$ ' is the number of credits of the  $i^{\text{th}}$  course and ' $G_i$ ' is the grade point scored by the student in the  $i^{\text{th}}$  course.

- c) The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a program,

$$\text{i.e. CGPA} = \sum (C_i \times S_i) / \sum C_i$$

where ' $S_i$ ' is the SGPA of the  $i^{\text{th}}$  semester and ' $C_i$ ' is the total number of credits in that semester.

- d) The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

e) CGPA can be converted to percentage of marks :  $10 \times \text{CGPA} - 7.5$

- f) A student get in less than 40% of overall score and 40% in the semester end examination will be considered to have earned "F" grade. Combined Theory and Lab courses the student should get independently 40% in both theory and lab components else treated as failed in both. A student who obtains 'F' grade has to reappear for all the components of Semester End examination.

g) Audit/Certificate courses are graded as satisfactory or non-satisfactory only.

- h) At the end of each semester, the University issues grade sheet indicating the SGPA and CGPA of the student. However, grade sheet will not be issued to the student if he/she has any outstanding dues.

### **6.5. Betterment**

- a) A student may reappear for semester end examination only in the theory part of the course for improving the grade, subject to the condition that, her/his CGPA is  $\leq 6.75$ . In the case of reappearing, the grade obtained in reappearance or the earlier grade whichever is better will be considered.
- b) A Student can re-register in any course at any time before the completion of his/her program provided the University permits.
- c) A student cannot reappear for semester end examination in courses like Industrial Training,

courses with their L-T-P Structure 0-0-X, Minor Project, Major Project, Practice School and Term Paper.

- d) The student ceases to be eligible for award of B.Pharm. Degree with Honors, B.Pharm degree with First class and distinction, in case s/he takes up the betterment option.

## **7. REGISTRATION PROCESS**

For every course, the student has to undertake the registration process prior to commencement of the course-work, based on the following conditions;

- a) Registration into a course will be permitted only for such courses, which are offered by the program in that particular semester.
- b) In case a course has pre-requisites, all of them must be fulfilled.
- c) The University has the right to refuse registration process if a student does not turn up on the day of registration.
- d) Registration shall not be permitted after the fifth working day from the scheduled date of commencement of classes.
- e) Students can register for a maximum of 29 credits in a semester of their choice to meet their program requirements.
- f) In case of students, who wish to register for more credits through Overloading or less credits through Under-loading, have to seek prior permission from Dean-Academic.
- g) Students, who have opted for minor degree, Honors program or degree with specialization, can register for more number of credits in a Semester through Overloading.
- h) The University reserves the right to withdraw any elective course offered within one week of the commencement of the semester if sufficient numbers of students have not registered or for any other reasons. In such cases, the students are permitted to register for any other elective course of their choice provided they have fulfilled the eligibility conditions.
- i) The University reserves the right to cancel the registration of a student from a course or a semester or debar from the degree on disciplinary grounds.
- j) Within one week of the commencement of the semester, a student is permitted to substitute an elective course subject to availability with prior approval from Dean-Academic. However,

a student is not permitted to withdraw from compulsory course and substitute the same with an elective course.

- k) A student is solely responsible to ensure that all conditions for proper registration are satisfied, and there are no timetable clashes. The registration may be cancelled for a course or the entire semester either by the student or by the University if any irregularity is found at a later stage.

## **8. CREDITTRANSFER**

- a) Credit transfer from other University to K L University or vice versa is permitted only for under graduate program.
- b) Credit transfer from K L University to other University: Student studying in K L University can take transfer to another University under the following conditions:
- i. K L University has signed MOU with the University.
  - ii. However, a student, after seeking transfer from K L University can return to K L University after a semester or year. Based on courses done in the other University, equivalent credits shall be awarded to such students.
- c) Credit transfer from another University to K L University: A student studying in another University can take transfer to K L University under the following conditions:
- i. When a student seeks transfer, equivalent credits will be assigned to the student based on the courses studied by the student.
  - ii. The student, when transferred from other Universities, has to stick to the rules and regulations of K L University.
  - iii. To graduate from K L University, a student must study at least half of the minimum duration prescribed for a program at KLU.

## **9. ACADEMIC COUNSELING BOARD(ACB)**

Academic Counseling Board is constituted by the Dean, Academic, for each program separately. This board shall comprise of the Chairman, Board of Studies, of the relevant program, two (2) Professors and two (2) Associate Professors.

A student will be put under Academic Counseling Board in the following circumstances:

9.5.1. Has CGPA of less than 6.00.

9.5.2. Has 'F' grade in multiple courses.

The students under Academic Counseling Board may not be allowed to register for all regular courses in the semester, based on the recommendation of Academic Counseling Board and decision of Dean, Academic.

## **10. BACKLOGCOURSES**

A course is considered to be a backlog if the student has obtained 'F' grade in the course; the student has to re-appear for all components of semester end examinations in that course. However, student must successfully complete such a course in a maximum of four (4) consecutive attempts, failing which s/he must re-register for that course or a substitute course. The decision for substitute course shall be obtained from the Dean, Academic, based on the recommendations of the Board of Studies.

## **11. RUSTICATION**

A student may be rusticated from the University on disciplinary grounds, based on the recommendations of any committee or examination committee, by the Vice Chancellor.

## **12. AWARD OFDEGREES**

A student having cleared all the courses and met all the requirements for the award of degree with

- 1) CGPA between 4.5 to 5.5 will be awarded Passclass
- 2)  $CGPA < 6.75$  will be awarded secondclass
- 3)  $CGPA \geq 6.75$  will be awarded firstclass
- 4)  $CGPA \geq 7.5$  will be awarded first class with distinction provided the student has cleared all the courses in first attempt, and must have fulfilled all the program requirements in four (4) years duration.

A student must have cleared minimum of 200-208 credits for under graduate B. Pharm programmes.

## **13. AWARD OFMEDALS**

University awards Gold and silver medals to the top two (2) students based on CGPA. However,

1. The grade obtained by betterment, will not be considered for this award.
2. She/he must have obtained first class with distinction for the award of Gold or silver medal. *Any of the above rules can be altered at the discretion of the Vice Chancellor in special situations.*

## CHAPTER- II: B.PHRAM. COURSE STRUCTURE

**Table-I: Course of study for semester I**

Course code	Name of the course	No. of Hours			Total Credits
		L	T	P	
16PH1101	Dispensing and General Pharmacy	3		4	5
16PH1102	Pharmaceutical Organic Chemistry I	3		4	5
16PH1103	English Communication Skills	1		-	1
16PH1104	Remedial Biology (optional)	2		2	3
16PH1105	Remedial Mathematics (optional)	2	-	-	2
16PH1106	Anatomy Physiology & Health Education	3	-	4	5
16PH1107	Pharmaceutical Inorganic Chemistry	3	-	4	5
	<b>Total</b>	<b>15</b>	<b>-</b>	<b>16<sup>\$</sup>/18<sup>#</sup></b>	<b>23<sup>\$</sup>/24<sup>#</sup></b>

<sup>#</sup>Applicable ONLY for the students who have studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB) course.

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

\* Non University Examination (NUE)

**Table-II: Course of study for semester II**

Course code	Name of the course	No. of Hours			Total Credits
		L	T	P	
16PH1208	Community Pharmacy	3	-	-	3
16PH1209	Pharmaceutical Organic Chemistry II	3	-	4	5
16PH1210	Pharmaceutical analysis I	3	-	4	5
16PH1211	Pharmacognosy I	3	-	4	5
16PH1212	Environmental science	3	-	-	3
16PH1213	Pharmaceutical biochemistry	3	-	4	5
	<b>Total</b>	<b>18</b>	<b>-</b>	<b>12</b>	<b>26</b>

**Table-III: Course of study for semester III**

Course code	Name of the course	No. of Hours			Total Credits
		L	T	P	
16PH2114	Physical Pharmaceutics I	3	1	4	6
16PH2115	Anatomy & Physiology	3	1	4	6
16PH2116	Pharmaceutical Engineering	3	1	4	6
16PH2117	Computer applications	3	1	4	6
	<b>Total</b>	<b>12</b>	<b>4</b>	<b>16</b>	<b>28</b>

**Table-IV: Course of study for semester IV**

Course code	Name of the course	No. of Hours			Total Credits
		L	T	P	
16PH2218	Pharmaceutical microbiology	3	1	4	6
16PH2219	Medicinal Chemistry I	3	1	4	6
16PH2220	Physical Pharmaceutics II	3	1	4	6
16PH2221	Pathophysiology	3	1	-	4
16PH2222	Pharmacology I	3	1	4	6
	<b>Total</b>	<b>15</b>	<b>5</b>	<b>16</b>	<b>28</b>

**Table-V: Course of study for semester V**

Course code	Name of the course	No. of Hours			Total Credits
		L	T	P	
16PH3123	Medicinal Chemistry II	3	1	-	4
16PH3124	Industrial Pharmacy I	3	1	4	6
16PH3125	Pharmacology II	3	1	4	6
16PH3126	Pharmacognosy and Phytochemistry II	3	1	4	6
16PH3127	Pharmaceutical Jurisprudence	3	1	-	4
	<b>Total</b>	<b>15</b>	<b>5</b>	<b>12</b>	<b>26</b>

**Table-VI: Course of study for semester VI**

Course code	Name of the course	No. of Hours			Total Credits
		L	T	P	
16PH3228	Medicinal Chemistry III	3	1	4	6
16PH3229	Pharmacology III	3	1	4	6
16PH3230	Herbal Drug Technology	3	1	4	6
16PH3231	Biopharmaceutics and Pharmacokinetics	3	1	-	4
16PH3232	Pharmaceutical Biotechnology	3	1	-	4
16PH3233	Quality Assurance	3	1	-	4
	<b>Total</b>	<b>18</b>	<b>6</b>	<b>12</b>	<b>30</b>

**Table-VII: Course of study for semester VII**

Course code	Name of the course	No. of Hours			Total Credits
		L	T	P	
16PH4134	Instrumental Methods of Analysis	3	1	4	6
16PH4135	Industrial Pharmacy II	3	1	-	4
16PH4136	Pharmacy Practice	3	1	-	4
16PH4137	Novel Drug Delivery System	3	1	-	4
16PH4138	Practice School*	12	-	-	6
	<b>Total</b>	<b>28</b>	<b>5</b>	<b>4</b>	<b>24</b>

\*Non University Examination (NUE)

**Table-VIII: Course of study for semester VIII**

Course code	Name of the course	No. of Hours			Total Credits
		L	T	P	
16PH4239	Biostatistics and Research Methodology	3	1		4
16PH4240	Social and Preventive Pharmacy	3	1		4
16PH4241ET	Pharma Marketing Management	3 + 3	1 + 1		4 + 4 = 8
16PH4242ET	Pharmaceutical Regulatory Science				
16PH4243ET	Pharmacovigilance				
16PH4244ET	Quality Control and Standardization of Herbals				
16PH4245ET	Computer Aided Drug Design				
16PH4246ET	Cell and Molecular Biology				
16PH4247ET	Cosmetic Science				
16PH4248ET	Experimental Pharmacology				
16PH4249ET	Advanced Instrumentation Techniques				
16PH4250ET	Dietary Supplements and Nutraceuticals				
16PH4251PW	Project Work	12			6
		<b>24</b>	<b>4</b>	<b>0</b>	<b>22</b>

**Table-IX: Semester wise credits distribution**

Semester	Credit Points
I	23 <sup>\$</sup> /24 <sup>#</sup>
II	26
III	28
IV	28
V	26
VI	30
VII	24
VIII	22
Extracurricular/ Co-curricular activities	01*
<b>Total credit points for the program</b>	<b>208<sup>\$</sup>/209<sup>#</sup></b>

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

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

\* The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University. The criteria to acquire this credit point shall be defined by the colleges from time to time.





## 6. Course Structure which contains mapping of POs

S.No	COURSE CODE	COURSE NAME	LTP	CR	PRE REQ.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
<b>SEMESTER-I</b>															
1	16PH1101	DISPENSING AND GENERAL PHARMACY	3-0-4	5	–	3						2			
2	16PH1102	PHARMACEUTICAL ORGANIC CHEMISTRY I	3-0-4	5	–		2							1	
3	16PH1103	ENGLISH COMMUNICATION SKILLS	1-0-0	1	–						3	2			
4	16PH1104	REMEDIAL BIOLOGY (OPTIONAL)	2-0-2	3	–	1									
5	16PH1105	REMEDIAL MATHEMATICS (OPTIONAL)	2-0-0	2	–	1									
6	16PH1106	ANATOMY PHYSIOLOGY & HEALTH EDUCATION	3-0-4	5	–	2			1						
7	16PH1107	PHARMACEUTICAL INORGANIC CHEMISTRY	3-0-4	5	–	1			2						
<b>SEMESTER-II</b>															
8	16PH1208	COMMUNITY PHARMACY	3-0-0	3	–	3						2			
9	16PH1209	PHARMACEUTICAL ORGANIC CHEMISTRY II	3-0-4	5	–		2							1	
10	16PH1210	PHARMACEUTICAL ANALYSIS I	3-0-4	5	–	1	2								
11	16PH1211	PHARMACOGNOSY I	3-0-4	5	–	3								2	

12	16PH1212	ENVIRONMENTAL SCIENCE	3-0-0	3	–				1			2			
13	16PH1213	PHARMACEUTICAL BIOCHEMISTRY	3-0-4	5	–	2			1						
<b>SEMESTER-III</b>															
14	16PH2114	PHYSICAL PHARMACEUTICS-I	3-1-4	6	–	3						2			
15	16PH2115	ANATOMY & PHYSIOLOGY	3-1-4	6	–	2			1						
16	16PH2116	PHARMACEUTICAL ENGINEERING	3-1-4	6	–	3						2			
17	16PH2117	COMPUTER APPLICATIONS	3-1-4	6	–			3							1
<b>SEMESTER-IV</b>															
18	16PH2218	PHARMACEUTICAL MICROBIOLOGY	3-1-4	6	–					2			1		
19	16PH2219	MEDICINAL CHEMISTRY – I	3-1-4	6	–	3								2	
20	16PH2220	PHYSICAL PHARMACEUTICS-II	3-1-4	6	–	1	2								
21	16PH2221	PATHOPHYSIOLOGY	3-1-0	4	–	2	1								
22	16PH2222	PHARMACOLOGY-I	3-1-4	6	–	3				1					
<b>SEMESTER-V</b>															
23	16PH3123	MEDICINAL CHEMISTRY II	3-1-0	4	–	3	3		2						
24	16PH3124	INDUSTRIAL PHARMACY I	3-1-4	6	–	3	3							1	
25	16PH3125	PHARMACOLOGY II	3-1-4	6	–	3	3		1						
26	16PH3126	PHARMACOGNOSY AND PHYTOCHEMISTRY II	3-1-4	6	–	3	3								1

27	16PH3127	PHARMACEUTICAL JURISPRUDENCE	3-1-0	4	–	3							1		
<b>SEMESTER-VI</b>															
28	16PH3228	MEDICINAL CHEMISTRY – III	3-1-4	6	–	3	3		2					2	
29	16PH3229	PHARMACOLOGY-III	3-1-4	6	–	3	3		1						
30	16PH3230	HERBAL DRUG TECHNOLOGY	3-1-4	6	–	2	3								3
31	16PH3231	BIOPHARMACEUTICS AND PHARMACOKINETICS	3-1-0	4	–		2							1	
32	16PH3232	PHARMACEUTICAL BIOTECHNOLOGY	3-1-0	4	–	1			2					2	
33	16PH3233	PHARMACEUTICAL QUALITY ASSURANCE	3-1-4	6	–	3								2	
<b>SEMESTER-VII</b>															
34	16PH4134	INSTRUMENTAL METHODS OF ANALYSIS	3-1-4	6	–		2		1						
35	16PH4135	INDUSTRIAL PHARMACYII	3-1-4	6	–	2								3	
36	16PH4136	PHARMACY PRACTICE	3-1-4	6	–					2		3			
37	16PH4137	NOVEL DRUG DELIVERY SYSTEMS	3-1-4	6	–		3							3	2
38	16PH4138	PRACTICE SCHOOL	12-0-0	6	–		2							3	
<b>SEMESTER-VIII</b>															
39	16PH4239	BIOSTATISTICS AND RESEARCH METHODOLOGY	3-1-0	6	–				3	1					
40	16PH4240	SOCIAL AND PREVENTIVE PHARMACY	3-1-0	4	–							3	2		
41	16PH4241ET	PHARMA MARKETING MANAGEMENT	2	2X4	–						3				2

42	16PH4242ET	PHARMACEUTICAL REGULATORY SCIENCE	X 3-1-0		–	3								2	
43	16PH4243ET	PHARMACOVIGILANCE			–						3				2
44	16PH4244ET	QUALITY CONTROL AND STANDARDIZATION OF HERBALS			–		3							2	
45	16PH4245ET	COMPUTER AIDED DRUG DESIGN			–			3							2
46	16PH4246ET	CELL AND MOLECULAR BIOLOGY			–		2		3						
47	16PH4247ET	COSMETIC SCIENCE			–									3	2
48	16PH4248ET	EXPERIMENTAL PHARMACOLOGY			–		2		3						
49	16PH4249ET	ADVANCED INSTRUMENTATION TECHNIQUES			–		3		2						
50	16PH4250ET	DIETARY SUPPLEMENTS AND NUTRACEUTICALS			–									3	2
51	16PH4251P W	PROJECT WORK	12-0- 0	6	–		2		3					1	1

**\*ET-Elective**

## 7. Syllabus

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1101: DISPENSING AND GENERAL PHARMACY	CO1	Know the history of profession of pharmacy	1,7	1,2
	CO2	Understand the basics of different dosage forms	1,7	1,2
	CO3	Understand the pharmaceutical incompatibilities and pharmaceutical calculations	1,7	1,2
	CO4	Understand the professional way of handling the prescription	1,7	1,2
	CO5	Apply the knowledge to prepare various conventional dosage forms	2,PSO1	2,3
<p>•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.</p> <p>•Dosage forms: Introduction to dosage forms, classification and definitions</p> <p>•Prescription: Definition, Parts of prescription, handling of Prescription and Errors in prescription.</p> <p>•Posology: Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.</p> <p>•Pharmaceutical calculations: Weights and measures – Imperial &amp; Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.</p> <p>•Powders: Definition, classification, advantages and disadvantages, Simple &amp; compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.</p> <p>•Liquid dosage forms: Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques.</p> <p>•Monophasic liquids: Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.</p> <p>•Biphasic liquids:</p> <p>•Suspensions: Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension &amp; stability problems and methods to overcome.</p> <p>•Emulsions: Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation &amp; stability problems and methods to overcome.</p> <p>•Suppositories: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value &amp; its calculations, evaluation of suppositories.</p> <p>•Pharmaceutical incompatibilities: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.</p> <p>•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</p> <p>16PH1101. DISPENSING AND GENERAL PHARMACY (Practical)</p> <p>1. Syrups</p> <p>a) Syrup IP'66</p> <p>b) Compound syrup of Ferrous Phosphate BPC'68</p> <p>2. Elixirs</p> <p>a) Piperazine citrate elixir</p> <p>b) Paracetamol pediatric elixir</p> <p>3. Linctus</p> <p>a) Terpin Hydrate Linctus IP'66</p> <p>b) Iodine Throat Paint (Mandles Paint)</p>				

4. Solutions
  - a) Strong solution of ammonium acetate
  - b) Cresol with soap solution
  - c) Lugol's solution
5. Suspensions
  - a) Calamine lotion
  - b) Magnesium Hydroxide mixture
  - c) Aluminium Hydroxide gel
6. Emulsions
  - a) Turpentine Liniment
  - b) Liquid paraffin emulsion
7. Powders and Granules
  - a) ORS powder (WHO)
  - b) Effervescent granules c) Dusting powder d) Divided powders
8. Suppositories
  - a) Glycero gelatin suppository
  - b) Cocoa butter suppository
  - c) Zinc Oxide suppository
8. Semisolids
  - a) Sulphur ointment
  - b) Non staining-iodine ointment with methyl salicylate
  - c) Carbopal gel
9. Gargles and Mouthwashes
  - a) Iodine gargle
  - b) Chlorhexidine mouthwash

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1102: PHARMACEUTICAL ORGANIC CHEMISTRY –I	CO1	write the structure, name and the type of isomerism of the organic compound	2,PSO1	1,2
	CO2	write the reaction, name the reaction and orientation of reactions	2,PSO1	1,2
	CO3	account for reactivity/stability of compounds,	2,PSO1	1,2
	CO4	identify/confirm the identification of organic compound	2,PSO1	1,2
	CO5	Apply the knowledge to synthesize various organic compounds	2,PSO1	2,3

•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

•Alkanes\*, Alkenes\* and Conjugated dienes\*

SP<sup>3</sup> hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP<sup>2</sup> hybridization in alkenes

E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E1 versus 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

•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

•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, Vanillin, Cinnamaldehyde.

•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

16PH1102: PHARMACEUTICAL ORGANIC CHEMISTRY –I (Practical)

1. Systematic qualitative analysis of unknown organic compounds like
1. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc.
2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test
3. Solubility test
4. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides.
5. Melting point/Boiling point of organic compounds
6. Identification of the unknown compound from the literature using melting point/ boiling point.
7. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point.
8. Minimum 5 unknown organic compounds to be analysed systematically.
2. Preparation of suitable solid derivatives from organic compounds
3. Construction of molecular models

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1103:COMMUNICATION SKILLS	CO1	Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation	6,7	2,3
	CO2	Communicate effectively (Verbal and Non Verbal)	6,7	2,3
	CO3	Effectively manage the team as a team player	6,7	2,3
	CO4	Develop interview skills	6,7	2,3
	CO5	Demonstrate communicative skills.	1,2	2,3
<p>•Communication Skills: Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context</p> <p>•Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers</p> <p>•Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment</p> <p>•Elements of Communication: Introduction, Face to Face Communication - Tone of Voice, Body Language</p>				

(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
- 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
- Interview Skills: Purpose of an interview, Do's and Dont's of an interview
- Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery
- Group Discussion: Introduction, Communication skills in group discussion, Do's and Dont's of group discussion

16PH1103:COMMUNICATION SKILLS (Practical)

Thefollowing learning modules are to be conducted using wordsworth® English language lab software  
Basic communication covering the following topics

Meeting People Asking Questions Making Friends What did you do? Do's and Dont's

Pronunciations covering the following topics Pronunciation (Consonant Sounds) Pronunciation and Nouns  
Pronunciation (Vowel Sounds)

Advanced Learning

Listening Comprehension / Direct and Indirect Speech Figures of Speech

Effective Communication Writing Skills

Effective Writing Interview Handling Skills E-Mail etiquette Presentation Skills

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1104: REMEDIAL BIOLOGY	CO1	Introduce biology to non biology students	1	1,2
	CO2	know the classification and salient features of five kingdoms of life	1	1,2
	CO3	understand the basic components of anatomy & physiology of plant	1	1,2
	CO4	know understand the basic components of anatomy & physiology animal with special reference to human	1	1,2
	CO5	Perform various biology experiments	1,2	2,3

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, Protista, 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 & Dicotyledones.

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

## Excretory products and their elimination

- Modes of excretion
- Human excretory system- structure and function
- Urine formation
- Renin 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

## 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.

## Plant respiration: 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.

## 16PH1104: REMEDIAL BIOLOGY (Practical)

1. Introduction to experiments in biology
  - a) Study of Microscope
  - b) Section cutting techniques
  - c) Mounting and staining
  - d) Permanent slide preparation
2. Study of cell and its inclusions
3. Study of Stem, Root, Leaf, seed, fruit, flower and their modifications
4. Detailed study of frog by using computer models
5. Microscopic study and identification of tissues pertinent to Stem, Root Leaf, seed, fruit and flower
6. Identification of bones

7.	Determination of blood group			
8.	Determination of blood pressure			
9.	Determination of tidal volume			
COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1105: REMEDIAL MATHEMATICS	CO1	Introduce essential of mathematics to biology students	1	1,2
	CO2	Know the theory and their application in Pharmacy	1	1,2
	CO3	Solve the different types of problems by applying theory	1	1,2
	CO4	Appreciate the important application of mathematics in Pharmacy	1	1,2
<p>•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</p> <p>•Logarithms Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.</p> <p>•Function: Real Valued function, Classification of real valued functions,</p> <p>•Limits and continuity : Introduction , Limit of a function, Definition of limit of a function ( <math>\epsilon</math> - <math>\delta</math> definition) , <math>\lim_{x \rightarrow a} \frac{x-a}{x-a} = na^{n-1}</math> , <math>\lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta} = 1</math>,</p> <p>•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</p> <p>•Calculus Differentiation : Introductions, Derivative of a function, Derivative of a 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 <math>x^n</math> w.r.t.x, where n is any rational number, Derivative of <math>e^x</math>, Derivative of <math>\log_e x</math> , Derivative of <math>a^x</math>, Derivative of trigonometric functions from first principles (without Proof), Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application</p> <p>•Analytical Geometry Introduction: Signs of the 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</p> <p>Integration: Introduction, Definition, Standard formulae, Rules of integration , Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application.</p> <p>•Differential Equations : Some basic definitions, Order and degree, Equations in separable form , Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations</p> <p>•Laplace Transform : Introduction, Definition, Properties of Laplace transform, Laplace Transforms of</p>				

elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, Application in solving Chemical kinetics and Pharmacokinetics equations

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1106: ANATOMY PHYSIOLOGY AND HEALTH EDUCATION	CO1	Explain the gross morphology, structure and functions of various organs of the human body.	1,4	1,2
	CO2	Describe the various homeostatic mechanisms and their imbalances.	1,4	1,2
	CO3	Identify the various tissues and organs of different systems of human body.	1,4	1,2
	CO4	Understand the organ functions	1,4	1,2
	CO5	Perform the various experiments related to physiology and health.	1,2	2,3

- 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.
- 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
- Body fluids and blood
- Body fluids, composition and functions of blood, hemopoiesis, 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
- 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.
- 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 heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.

16PH1106: ANATOMY PHYSIOLOGY AND HEALTH EDUCATION (Practical)

- 1.Study of compound microscope.
- 2.Microscopic study of epithelial and connective tissue
- 3.Microscopic study of muscular and nervous tissue
- 4.Identification of axial bones

5. Identification of appendicular bones
6. Introduction to hemocytometry.
7. Enumeration of white blood cell (WBC) count
8. Enumeration of total red blood corpuscles (RBC) count
9. Determination of bleeding time
10. Determination of clotting time
11. Estimation of hemoglobin content
12. Determination of blood group.
13. Determination of erythrocyte sedimentation rate (ESR).
14. Determination of heart rate and pulse rate.
15. Recording of blood pressure.

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1107: PHARMACEUTICAL INORGANIC CHEMISTRY	CO1	know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals	1,4	1,2
	CO2	understand the medicinal and pharmaceutical importance of inorganic compounds	1,4	1,2
	CO3	Know the preparation and analysis of inorganic medicinal compounds	1,4	1,2
	CO4	Know their diagnostic applications	1,4	1,2
	CO5	Apply the knowledge to prepare various inorganic pharmaceuticals	1,2	2,3

• 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

• 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 eugenol cement.

• Gastrointestinal agents

Acidifiers: Ammonium chloride\* 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

• 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, Sodium nitrite

Astringents: Zinc Sulphate, Potash Alum

• Radiopharmaceuticals: Radio activity, Measurement of radioactivity, Properties of  $\alpha$ ,  $\beta$ ,  $\gamma$  radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances.

16PH1107: PHARMACEUTICAL INORGANIC CHEMISTRY(Practical)

I Limit tests for following ions  
 Limit test for Chlorides and Sulphates Modified limit test for Chlorides and Sulphates Limit test for Iron  
 Limit test for Heavy metals Limit test for Lead  
 Limit test for Arsenic II Identification test  
 Magnesium hydroxide Ferrous sulphate Sodium bicarbonate Calcium gluconate Copper sulphate  
 III Test for purity  
 Swelling power of Bentonite  
 Neutralizing capacity of aluminum hydroxide gel  
 Determination of potassium iodate and iodine in potassium Iodide  
 IV Preparation of inorganic pharmaceuticals  
 Boric acid Potash alum Ferrous sulphate

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1208: COMMUNITY PHARMACY	CO1	Know the history of profession of pharmacy	1,7	1,2
	CO2	Understand the basics of different dosage forms	1,7	1,2
	CO3	Understand the pharmaceutical incompatibilities and pharmaceutical calculations	1,7	1,2
	CO4	Understand the professional way of handling the prescription	1,7	1,2

- Definition, scope, of community pharmacy Roles and responsibilities of Community pharmacist Community Pharmacy Management a) Selection of site, Space layout, and design b) Staff, Materials-coding, stocking c) Legal requirements d) Maintenance of various registers e) Use of Computers: Business and health care soft wares
- Prescriptions – parts of prescription, legality & identification of medication related problems like drug interactions. 4 Inventory control in community pharmacy Definition, various methods of Inventory Control ABC, VED, EOQ, Lead time, safety stock 5 Pharmaceutical care Definition and Principles of Pharmaceutical care. Patient counselling Definition, outcomes, various stages, barriers, Strategies to overcome barriers Patient information leaflets- content, design, & layouts, advisory labels . Patient medication adherence Definition, Factors affecting medication adherence, role of pharmacist in improving the adherence.
- Health screening services Definition, importance, methods for screening Blood pressure/ blood sugar/ lung function and Cholesterol testing . OTC Medication- Definition, OTC medication list & Counselling . Health Education WHO Definition of health, and health promotion, care for children, pregnant & breast feeding women, and geriatric patients. Commonly occurring Communicable Diseases, causative agents, Clinical presentations and prevention of communicable diseases – Tuberculosis, Hepatitis, Typhoid, Amoebiasis, Malaria, Leprosy, Syphilis, Gonorrhea and AIDS Balance diet, and treatment & prevention of deficiency disorders Family planning – role of pharmacist .
- Responding to symptoms of minor ailments Relevant pathophysiology, common drug therapy to, Pain, GI disturbances (Nausea, Vomiting, Dyspepsia, diarrhea, constipation), Pyrexia, Ophthalmic symptoms, worms infestations. Essential Drugs concept and Rational Drug Therapy Role of community pharmacist. Code of ethics for community pharmacis

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1209: PHARMACEUTICAL ORGANIC CHEMISTRY –II	CO1	write the structure, name and the type of isomerism of the organic compound	2,PSO1	1,2
	CO2	write the reaction, name the reaction and orientation of reactions	2,PSO1	1,2
	CO3	account for reactivity/stability of compounds,	2,PSO1	1,2
	CO4	prepare organic compounds	2,PSO1	1,2
	CO5	Apply the knowledge to synthesize various organic compounds	2,PSO1	2,3

•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 substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction

D.Structure and uses of DDT, Saccharin, BHC and Chloramine

•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.

•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.

•Polynuclear hydrocarbons:

a.Synthesis, reactions

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

•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

16PH1209: PHARMACEUTICAL ORGANIC CHEMISTRY –II (Practical)

I Experiments involving laboratory techniques

• Recrystallization

• Steam distillation

II Determination of following oil values (including standardization of reagents)

• Acid value

• Saponification value

• Iodine value

III Preparation of compounds

• Benzanilide/Phenyl benzoate/Acetanilide from Aniline/Phenol

/Aniline by acylation reaction.

• 2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/

Acetanilide by halogenation (Bromination) reaction.

• 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction.

• Benzoic acid from Benzyl chloride by oxidation reaction.

• Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.

• 1-Phenyl azo-2-naphthol from Aniline by diazotization and coupling reactions.

• Benzil from Benzoin by oxidation reaction.

• Dibenzal acetone from Benzaldehyde by Claisen Schmidt reaction

• Cinnamic acid from Benzaldehyde by Perkin reaction

• P-Iodo benzoic acid from P-amino benzoic acid

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1210: PHARMACEUTICAL	CO1	understand the principles of volumetric and electro chemical analysis	1,2	1,2

ANALYSIS-I	CO2	carryout various volumetric and electrochemical titrations	1,2	1,2
	CO3	develop analytical skills	1,2	1,2
	CO4	Reporting analytical result and data integrity	1,2	1,2
	CO5	Perform various analytical experiments	1,2	2,3
<p>(a) Pharmaceutical analysis- Definition and scope</p> <p>i) Different techniques of analysis</p> <p>ii) Methods of expressing concentration</p> <p>iii) Primary and secondary standards.</p> <p>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</p> <p>(b)Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures</p> <p>(c)Pharmacopoeia, Sources of impurities in medicinal agents,limit tests.</p> <ul style="list-style-type: none"> <li>•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</li> <li>•Non aqueous titration: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl</li> <li>•Precipitation titrations:Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.</li> <li>•Gravimetry: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.</li> <li>•Complexometric titration: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.</li> <li>•Basic Principles,methods and application of diazotisation titration.</li> </ul> <p>Redox titrations</p> <p>(a)Concepts of oxidation and reduction</p> <p>(b)Types of redox titrations (Principles and applications)</p> <p>Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate</p> <ul style="list-style-type: none"> <li>•Electrochemical methods of analysis</li> <li>•Conductometry- Introduction, Conductivity cell, Conductometric titrations, applications.</li> <li>•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.</li> <li>•Polarography - Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications</li> </ul> <p>16PH1210: PHARMACEUTICAL ANALYSIS (Practical)</p> <p>I Limit Test of the following</p> <p>(1) Chloride</p> <p>(2) Sulphate</p> <p>(3) Iron</p> <p>(4) Arsenic</p> <p>II Preparation and standardization of</p> <p>(1) Sodium hydroxide</p> <p>(2) Sulphuric acid</p> <p>(3) Sodium thiosulfate</p> <p>(4) Potassium permanganate</p> <p>(5) Ceric ammonium sulphate</p> <p>III Assay of the following compounds along with Standardization of Titrant</p> <p>(1) Ammonium chloride by acid base titration</p>				

- (2) Ferrous sulphate by Cerimetry
- (3) Copper sulphate by Iodometry
- (4) Calcium gluconate by complexometry
- (5) Hydrogen peroxide by Permanganometry
- (6) Sodium benzoate by non-aqueous titration
- (7) Sodium Chloride by precipitation titration
- IV Determination of Normality by electro-analytical methods
- (1) Conductometric titration of strong acid against strong base
- (2) Conductometric titration of strong acid and weak acid against strong base
- (3) Potentiometric titration of strong acid against strong base

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1211 :PHARMACOGNOSY I	CO1	to know the techniques in the cultivation and production of crude drugs	1,PSO1	1,2
	CO2	to know the crude drugs, their uses and chemical nature	1,PSO1	1,2
	CO3	know the evaluation techniques for the herbal drugs	1,PSO1	1,2
	CO4	Understand the microscopic and morphological features of crude drugs	1,PSO1	1,2
	CO5	Perform the microscopic experiments and morphological evaluation of crude drugs	1,2	2,3

#### 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 sero taxonomical 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.

#### 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

#### 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

#### 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

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 : Gelatin, 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

16PH1211 :PHARMACOGNOSY I (Practical)

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

2. Determination of stomatal number and index

3. Determination of vein islet number, vein islet termination and palisade ratio.

4. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer

5. Determination of Fiber length and width

6. Determination of number of starch grains by Lycopodium spore method

7. Determination of Ash value

8. Determination of Extractive values of crude drugs

9. Determination of moisture content of crude drugs

10. Determination of swelling index and foaming

COURSE	CO	Course Outcome's	PO/PSO	BTL
17PH1212 : ENVIRONMENTAL SCIENCES	CO1	Create the awareness about environmental problems among learners.	4,7	1,2
	CO2	Impart basic knowledge about the environment and its allied problems.	4,7	1,2
	CO3	Develop an attitude of concern for the environment.	4,7	1,2
	CO4	Motivate learner to participate in environment protection and environment improvement.	7,8	1,2

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.

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)

Environmental Pollution: Air pollution; Water pollution; Soil pollution

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1213 : PHARMACEUTICAL BIOCHEMISTRY	CO1	Understand the principles of chemistry in biology	1,4	1,2
	CO2	Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.	1,4	1,2

	CO3	Understand the metabolism of nutrient molecules in physiological and pathological conditions.	1,4	1,2
	CO4	Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.	1,4	1,2
	CO5	Apply the knowledge to estimate various biochemical parameters in physiological systems	1,2	2,3

•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

•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 its mechanism.

Oxidative phosphorylation & its mechanism and substrate level phosphorylation

Inhibitors ETC and oxidative phosphorylation/Uncouplers

•Lipid metabolism

$\beta$ -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 (Phenylketonuria, Albinism, alpeptonuria, tyrosinemia)

Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline

Catabolism of heme; hyperbilirubinemia and jaundice

•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

•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

**16PH1213 : PHARMACEUTICAL BIOCHEMISTRY (Practical)**

1. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
2. Identification tests for Proteins (albumin and Casein)
3. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
4. Qualitative analysis of urine for abnormal constituents
5. Determination of blood creatinine
6. Determination of blood sugar
7. Determination of serum total cholesterol
8. Preparation of buffer solution and measurement of pH
9. Study of enzymatic hydrolysis of starch
10. Determination of Salivary amylase activity
11. Study the effect of Temperature on Salivary amylase activity.
12. Study the effect of substrate concentration on salivary amylase activity.

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH2114: PHYSICAL PHARMACEUTICS-I	CO1	Understand the principles of physical chemistry in pharmaceutical technology	1,2	1,2
	CO2	Understand various physicochemical properties of drug molecules in the designing the dosage forms	1,2	1,2
	CO3	Know the principles of chemical kinetics & to use them for stability testing nad determination of expiry date of formulations	1,2	1,2
	CO4	Understand the use of physicochemical properties in the formulation development and evaluation of dosage forms.	1,2	1,2
	CO5	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.	1,2	2,3

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

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

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.

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.

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

**17PH2114P. PHYSICAL PHARMACEUTICS – I (Practical)**

1. Determination the solubility of drug at room temperature
2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
3. Determination of Partition co- efficient of benzoic acid in benzene and water

4. Determination of Partition co- efficient of Iodine in CCl<sub>4</sub> and water
5. Determination of % composition of NaCl in a solution using phenol-water system by CST method
6. Determination of surface tension of given liquids by drop count and drop weight method
7. Determination of HLB number of a surfactant by saponification method
8. Determination of Freundlich and Langmuir constants using activated char coal
9. Determination of critical micellar concentration of surfactants
10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
11. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH1215: ANATOMY AND PHYSIOLOGY	CO1	Explain the gross morphology, structure and functions of various organs of the human body.	1,4	1,2
	CO2	Describe the various homeostatic mechanisms and their imbalances.	1,4	1,2
	CO3	Identify the various tissues and organs of different systems of human body.	1,4	1,2
	CO4	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.	1,4	1,2
	CO5	Apply the knowledge to perform various physiology experiments	1,2	2,3

•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)

•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.

•Respiratory system 12 hours

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.

•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.

•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

16PH1215: ANATOMY AND PHYSIOLOGY (Practical)

1. To study the integumentary and special senses using specimen, models, etc.,
2. To study the nervous system using specimen, models, etc.,
3. To study the endocrine system using specimen, models, etc
4. To demonstrate the general neurological examination
5. To demonstrate the function of olfactory nerve
6. To examine the different types of taste.
7. To demonstrate the visual acuity
8. To demonstrate the reflex activity
9. Recording of body temperature
10. To demonstrate positive and negative feedback mechanism.
11. Determination of tidal volume and vital capacity.
12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens.
13. Recording of basal mass index .
14. Study of family planning devices and pregnancy diagnosis test.
15. Demonstration of total blood count by cell analyser
16. Permanent slides of vital organs and gonads.

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH2116 : PHARMACEUTICAL ENGINEERING	CO1	To know various unit operations used in Pharmaceutical industries.	1,4	1,2
	CO2	To understand the material handling techniques.	1,4	1,2
	CO3	Understand various processes involved in pharmaceutical manufacturing process.	1,4	1,2
	CO4	Acquire knowledge on operation of pharmaceutical manufacturing equipment	1,4	1,2
	CO5	Demonstrate the ability to use and operate pharmaceutical manufacturing equipment	1,2	2,3

- 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.
- 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
- 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,
- 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.
- 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.

#### 16PH2116P - PHARMACEUTICAL ENGINEERING (Practical)

- Determination of radiation constant of brass, iron, unpainted and painted glass.
- Steam distillation – To calculate the efficiency of steam distillation.
- To determine the overall heat transfer coefficient by heat exchanger.
- Construction of drying curves (for calcium carbonate and starch).
- Determination of moisture content and loss on drying.
- Determination of humidity of air – i) from wet and dry bulb temperatures –use of Dew point method.
- Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
- Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots.
- Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
- Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
- Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/viscosity
- To study the effect of time on the Rate of Crystallization.
- To calculate the uniformity Index for given sample by using Double Cone Blender.

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH2117: COMPUTER APPLICATIONS IN PHARMACY	CO1	know the various types of application of computers in pharmacy	3,PSO2	2,3
	CO2	know the various types of databases	3,PSO2	2,3
	CO3	know the various applications of databases in pharmacy	3,PSO2	2,3
	CO4	Know the web based tools for pharmacy practice	3,PSO2	2,3
	CO5	Apply the knowledge to design and develp digital tools for pharmaceutical applications	6,PSO2	3,4

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  
 Programming languages, introduction to web servers and Server  
 Products  
 Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database

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

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

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

17PH1211P. COMPUTER APPLICATIONS IN PHARMACY (Practical)

1.Design a questionnaire using a word processing package to gather information about a particular disease.

2. Create a HTML web page to show personal information.

3 Retrieve the information of a drug and its adverse effects using online tools

4 Creating mailing labels Using Label Wizard , generating label in MS WORD

6.Create a database in MS Access to store the patient information with the required fields Using access

7. Design a form in MS Access to view, add, delete and modify the patient record in the database

8. Generating report and printing the report from patient database

9. Creating invoice table using – MS Access

10. Drug information storage and retrieval using MS Access

11. Creating and working with queries in MS Access

12. Exporting Tables, Queries, Forms and Reports to web pages

13. Exporting Tables, Queries, Forms and Reports to XML pages

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH2218 : PHARMACEUTICAL MICROBIOLOGY	CO1	Understand methods of identification, cultivation and preservation of various microorganisms	1,4	1,2
	CO2	To understand the importance and implementation of sterilization in pharmaceutical processing and industry	1,4	1,2
	CO3	Learn sterility testing of pharmaceutical products.	1,4	1,2
	CO4	Understand microbiological standardization of Pharmaceuticals.	1,4	1,2
	CO5	Apply microbiological testing tools in pharmaceutical products.	2,4	2,3

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.

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.

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.

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

Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids.

Assessment of a new antibiotic.

Types of spoilage, 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.

Application of cell cultures in pharmaceutical industry and research.

16PH22218.PHARMACEUTICAL MICROBIOLOGY (Practical)

1. Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology.
2. Sterilization of glassware, preparation and sterilization of media.
3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.
4. Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical).
5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.
6. Microbiological assay of antibiotics by cup plate method and other methods
7. Motility determination by Hanging drop method.
8. Sterility testing of pharmaceuticals.
9. Bacteriological analysis of water
10. Biochemical test.

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH2219: MEDICINAL CHEMISTRY – I	CO1	understand the chemistry of drugs with respect to their pharmacological activity	1	1,2
	CO2	understand the drug metabolic pathways, adverse effect and therapeutic value of drugs	1	1,2
	CO3	know the Structural Activity Relationship (SAR) of different class of drugs	1,4	1,2
	CO4	write the chemical synthesis of some drugs	1,4	1,2
	CO5	Perform chemical synthesis of some drugs	4,PSO1	2,3

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.

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.

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, Isoflurophate, 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, Piperidine hydrochloride, Procyclidine hydrochloride\*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

Drugs acting on Central Nervous System

A. Sedatives and Hypnotics:

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

Barbiturates: SAR of barbiturates, Barbitol\*, Phenobarbital, Mephobarbital, Amobarbital, Butobarbital, Pentobarbital, Secobarbital

Miscellaneous:

Amides & imides: Glutethimide.

Alcohol & their carbamate derivatives: Meprobamate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.

B. Antipsychotics

Phenothiazines: SAR of Phenothiazines - Promazine hydrochloride, Chlorpromazine hydrochloride\*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.

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

Fluorobutero-phenones: Haloperidol, Droperidol, Risperidone.

Beta amino ketones: Molindone hydrochloride.

Benzamides: Sulpieride.

C. Anticonvulsants: SAR of Anticonvulsants, mechanism of anticonvulsant action

Barbiturates: Phenobarbitone, Methobarbital. Hydantoins: Phenytoin\*, Mephentyoin, Ethotoin

Oxazolidine diones: Trimethadione, Paramethadione Succinimides: Phensuximide, Methsuximide,

Ethosuximide\* Urea and monoacylureas: Phenacemide, Carbamazepine\* Benzodiazepines: Clonazepam

Miscellaneous: Primidone, Valproic acid, Gabapentin, Felbamate

General anesthetics:

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

Ultra short acting barbiturates: 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, Anileridine 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, Zomepirac, Diclofenac, Ketorolac, Ibuprofen\*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.

#### 16PH2219. MEDICINAL CHEMISTRY – I (Practical)

I Preparation of drugs/ intermediates

1 1,3-pyrazole

2 1,3-oxazole

3 Benzimidazole

4 Benztriazole

5 2,3- diphenyl quinoxaline

6 Benzocaine

7 Phenytoin

8 Phenothiazine

9 Barbiturate

II Assay of drugs

1 Chlorpromazine

2 Phenobarbitone

3 Atropine

4 Ibuprofen

5 Aspirin

6 Furosemide

III Determination of Partition coefficient for any two drugs

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH2220 : PHYSICAL PHARMACEUTICS-II	CO1	Understand the principles of physical chemistry in pharmaceutical technology	1,4	1,2
	CO2	Understand various physicochemical properties of drug molecules in the designing the dosage forms	1,4	1,2
	CO3	Know the principles of chemical kinetics & to use them for stability testing nad determination of expiry date of formulations	1,4	1,2
	CO4	Understand the use of physicochemical properties in the formulation development and evaluation of dosage forms.	1,4	1,2
	CO5	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.	2,4	2,3

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, peptization & protective action.

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

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

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.

Micromeritics: 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.

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

#### 16PH2220. PHYSICAL PHARMACEUTICS- II (Practical)

1. Determination of particle size, particle size distribution using sieving method
2. Determination of particle size, particle size distribution using Microscopic method
3. Determination of bulk density, true density and porosity
4. Determine the angle of repose and influence of lubricant on angle of repose
5. Determination of viscosity of liquid using Ostwald's viscometer
6. Determination sedimentation volume with effect of different suspending agent
7. Determination sedimentation volume with effect of different concentration of single suspending agent
8. Determination of viscosity of semisolid by using Brookfield viscometer
9. Determination of reaction rate constant first order.
10. Determination of reaction rate constant second order
11. Accelerated stability studies

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH2221:PATHOPHYSIOLOGY	CO1	Understand the conditions leading to a disease	1,7	1,2
	CO2	Describe the etiology and pathogenesis of the selected disease states;	1,7	1,2
	CO3	Name the signs and symptoms of the diseases; and	1,7	1,2
	CO4	Mention the complications of the diseases.	1,7	1,2

#### •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 the skin, Pathophysiology of Atherosclerosis

#### •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.

#### •Haematological Diseases:

Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalassemia, 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
- 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
- Infectious diseases:Meningitis,Typhoid, Leprosy, Tuberculosis Urinary tract infections
- Sexually transmitted diseases:AIDS, Syphilis, Gonorrhea

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH2222 : PHARMACOLOGY-I	CO1	Understand the pharmacological actions of different categories of drugs	1,4	1,2
	CO2	Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.	1,4	1,2
	CO3	Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.	1,4	1,2
	CO4	Understand the effect of drugs on physiological systems	1,4	1,2
	CO5	Observe the effect of drugs on animals by simulated experiments	4	2,3

- General Pharmacology
  - Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists( competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.
  - Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs .Enzyme induction, enzyme inhibition, kinetics of elimination
- General Pharmacology
  - Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.
  - Adverse drug reactions.
  - Drug interactions (pharmacokinetic and pharmacodynamic)
  - Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.
- Pharmacology of drugs acting on peripheral nervous system
  - Organization and function of ANS.
  - Neurohumoral transmission,co-transmission and classification of neurotransmitters.
  - Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics.
  - Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).
  - Local anesthetic agents.
  - Drugs used in myasthenia gravis and glaucoma
- Pharmacology of drugs acting on central nervous system
  - Neurohumoral transmission in the C.N.S.special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.
  - General anesthetics and pre-anesthetics.
  - Sedatives, hypnotics and centrally acting muscle relaxants.
  - Anti-epileptics
  - Alcohols and disulfiram
  - Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics

and hallucinogens.

- Drugs used in Parkinsons disease and Alzheimer's disease.
- CNS stimulants and nootropics.
- Opioid analgesics and antagonists
- Drug addiction, drug abuse, tolerance and dependence.

#### 16PH2222.PHARMACOLOGY-I (Practical)

- Introduction to experimental pharmacology.
- Commonly used instruments in experimental pharmacology.
- Study of common laboratory animals.
- Maintenance of laboratory animals as per CPCSEA guidelines.
- Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
- Study of different routes of drugs administration in mice/rats.
- Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
- Effect of drugs on ciliary motility of frog oesophagus
- Effect of drugs on rabbit eye.
- Effects of skeletal muscle relaxants using rota-rod apparatus.
- Effect of drugs on locomotor activity using actophotometer.
- Anticonvulsant effect of drugs by MES and PTZ method.
- Study of stereotype and anti-catatonic activity of drugs on rats/mice.
- Study of anxiolytic activity of drugs using rats/mice.
- Study of local anesthetics by different methods

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH3123 : Medicinal Chemistry II	CO1	understand the chemistry of drugs with respect to their pharmacological activity	1,4	1,2
	CO2	understand the drug metabolic pathways, adverse effect and therapeutic value of drugs	1,4	1,2
	CO3	know the Structural Activity Relationship (SAR) of different class of drugs	1,4	1,2
	CO4	write the chemical synthesis of some drugs	1,4	1,2

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

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

H2-antagonists: Cimetidine\*, Famotidine, Ranitidin.

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

Anti-neoplastic agents:

Alkylating agents: Meclorothamine\*, 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.

Anti-anginal:

Vasodilators: Amyl nitrite, Nitroglycerin\*, Pentaerythritol tetranitrate, Isosorbide dinitrite\*, Dipyridamole.

Calciumchannelblockers: Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.

Diuretics:  
Carbonic anhydrase inhibitors: Acetazolamide\*, Methazolamide, Dichlorphenamide.  
Thiazides: Chlorthiazide\*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide,  
Loop diuretics: Furosemide\*, Bumetanide, Ethacrynic acid. Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride. Osmotic Diuretics: Mannitol  
Anti-hypertensive Agents: Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride, \* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.  
Anti-arrhythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate\*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcaïnide hydrochloride, Amiodarone, Sotalol.  
Anti-hyperlipidemic agents: Clofibrate, Lovastatin, Cholesteramine and Cholestipol  
Coagulant & Anticoagulants: Menadione, Acetomenadione, Warfarin\*, Anisindione, clopidogrel  
Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.  
Drugs acting on Endocrine system  
Nomenclature, Stereochemistry and metabolism of steroids  
Sex hormones: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol.  
Drugs for erectile dysfunction: Sildenafil, Tadalafil.  
Oral contraceptives: Mifepristone, Norgestrel, Levonorgestrol  
Corticosteroids: Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone  
Thyroid and antithyroid drugs: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.  
Antidiabetic agents:  
Insulin and its preparations  
Sulfonyl ureas: Tolbutamide\*, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin.  
Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide.  
Glucosidase inhibitors: Acarbose, Voglibose.  
Local Anesthetics: SAR of Local anesthetics  
Benzoic Acid derivatives; Cocaine, Hexylcaine, Mepylcaine, Cyclomethycaine, Piperocaine.  
Amino Benzoic acid derivatives: Benzocaine\*, Butamben, Procaine\*, Butacaine, Propoxycaine, Tetracaine, Benoxinate.  
Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine.  
Miscellaneous: Phenacaine, Dipreron, Dibucaine.\*

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH3124: Industrial Pharmacy I	CO1	Know the design and layout of various procedures in pharmaceutical industry	1,PSO1	1,2
	CO2	Know the various pharmaceutical dosage forms and their manufacturing techniques.	1,PSO1	1,2
	CO3	Know various considerations in development of pharmaceutical dosage forms	1,PSO1	1,2
	CO4	Understand the quality control of solid, liquid and semisolid dosage forms	1,PSO1	1,2
	CO5	Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality	2,PSO1	2,3
<p>Preformulation Studies: Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances.</p> <p>a. Physical properties: Physical form (crystal &amp; amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism</p> <p>b. Chemical Properties: Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs &amp; its significant</p> <p>Application of preformulation considerations in the development of solid, liquid oral and parenteral</p>				

dosage forms and its impact on stability of dosage forms.

#### Tablets:

- a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling.
- b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating.
- c. Quality control tests: In process and finished product tests

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

#### Capsules:

- a. Hard gelatin capsules: Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules.
- b. Soft gelatin capsules: Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.

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

#### Parenteral Products:

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

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

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

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

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

#### 16PH3124. Industrial Pharmacy (Practical)

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

COURSE	CO	Course Outcome's	PO/PSO	BTL
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16PH3125: Pharmacology II	CO1	Understand the mechanism of drug action and its relevance in the treatment of different diseases	1,4	1,2
	CO2	Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.	1,4	1,2
	CO3	Understand the effect of drugs on physiological systems	1,4	1,2
	CO4	Appreciate correlation of pharmacology with related medical sciences	1,4	1,2
	CO5	Perform various invitro experiments to demonstrate receptor actions using isolated tissue preparation	2,4	2,3
<p>1. Pharmacology of drugs acting on cardio vascular system</p> <p>a. Introduction to hemodynamic and electrophysiology of heart.</p> <p>b. Drugs used in congestive heart failure</p> <p>c. Anti-hypertensive drugs.</p> <p>d. Anti-anginal drugs.</p> <p>e. Anti-arrhythmic drugs.</p> <p>f. Anti-hyperlipidemic drugs.</p> <p>1. Pharmacology of drugs acting on cardio vascular system</p> <p>a. Drug used in the therapy of shock.</p> <p>b. Hematinics, coagulants and anticoagulants.</p> <p>c. Fibrinolytics and anti-platelet drugs</p> <p>d. Plasma volume expanders</p> <p>2. Pharmacology of drugs acting on urinary system</p> <p>a. Diuretics</p> <p>b. Anti-diuretics.</p> <p>3. Autocoids and related drugs</p> <p>a. Introduction to autacoids and classification</p> <p>b. Histamine, 5-HT and their antagonists.</p> <p>c. Prostaglandins, Thromboxanes and Leukotrienes.</p> <p>d. Angiotensin, Bradykinin and Substance P.</p> <p>e. Non-steroidal anti-inflammatory agents</p> <p>f. Anti-gout drugs</p> <p>g. Antirheumatic drugs</p> <p>5. Pharmacology of drugs acting on endocrine system</p> <p>a. Basic concepts in endocrine pharmacology.</p> <p>b. Anterior Pituitary hormones- analogues and their inhibitors.</p> <p>c. Thyroid hormones- analogues and their inhibitors.</p> <p>d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D.</p> <p>d. Insulin, Oral Hypoglycemic agents and glucagon.</p> <p>e. ACTH and corticosteroids.</p> <p>5. Pharmacology of drugs acting on endocrine system</p> <p>a. Androgens and Anabolic steroids.</p> <p>b. Estrogens, progesterone and oral contraceptives.</p> <p>c. Drugs acting on the uterus.</p> <p>6. Bioassay</p> <p>a. Principles and applications of bioassay. b.Types of bioassay</p> <p>c. Bioassay of insulin, oxytocin, vasopressin, ACTH,d-tubocurarine,digitalis, histamine and 5-HT</p> <p>16PH3125 P. PHARMACOLOGY-II (Practical)</p> <p>1. Introduction to in-vitro pharmacology and physiological salt solutions.</p> <p>2. Effect of drugs on isolated frog heart.</p> <p>3. Effect of drugs on blood pressure and heart rate of dog.</p>				



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

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH3126 : Pharmacognosy and Phytochemistry II	CO1	to know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents	1,PSO2	1,2
	CO2	to understand the preparation and development of herbal formulation.	1,PSO2	1,2
	CO3	to understand the herbal drug interactions	1,PSO2	1,2
	CO4	Understand the isolation procedures and identification of phytoconstituents	1,PSO2	1,2
	CO5	to carryout isolation and identification of phytoconstituents	2,PSO1	2,3

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.

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, Aloe, Bitter Almond

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

Isolation, Identification and Analysis of Phytoconstituents

a) Terpenoids: Menthol, Citral, Artemisin

b) Glycosides: Glycyrrhetic acid & Rutin

c) Alkaloids: Atropine, Quinine, Reserpine, Caffeine

d) Resins: Podophyllotoxin, Curcumin

Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine

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.

16PH3126. PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical)

1. Morphology, histology and powder characteristics & extraction & detection of: Cinchona,

Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander

2. Exercise involving isolation & detection of active principles
  - a. Caffeine - from tea dust.
  - b. Diosgenin from Dioscorea
  - c. Atropine from Belladonna
  - d. Sennosides from Senna
3. Separation of sugars by Paper chromatography
4. TLC of herbal extract
5. Distillation of volatile oils and detection of phytoconstituents by TLC
6. Analysis of crude drugs by chemical tests: (i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH3127 : PHARMACEUTICAL JURISPRUDENCE	CO1	The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.	1,8	1,2
	CO2	Various Indian pharmaceutical Acts and Laws	1,8	1,2
	CO3	The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals	1,8	1,2
	CO4	The code of ethics during the pharmaceutical practice	1,8	1,2

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.

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

Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties.

Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors

- 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
- 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)
- 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, Pharmacist's oath
- Medical Termination of Pregnancy Act
- Right to Information Act
- Introduction to Intellectual Property Rights (IPR)

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH3228: MEDICINAL CHEMISTRY – III	CO1	Understand the importance of drug design and different techniques of drug design.	1,4	1,2
	CO2	Understand the chemistry of drugs with respect to their biological activity.	1,4	1,2
	CO3	Know the metabolism, adverse effects and therapeutic value of drugs.	1,4	1,2
	CO4	Know the importance of SAR of drugs.	1,4	1,2
	CO5	Perform synthesis and SAR of drugs.	2,PSO1	2,3

#### 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

Tetracyclines: Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline

#### Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

Macrolide: Erythromycin Clarithromycin, Azithromycin.

Miscellaneous: Chloramphenicol\*, Clindamycin.

Prodrugs: Basic concepts and application of prodrugs design.

Antimalarials: Etiology of malaria.

Quinolines: SAR, Quininesulphate, Chloroquine\*, Amodiaquine, Primaquine phosphate, Pamaquine\*, Quinacrine hydrochloride, Mefloquine.

Biguanides and dihydro triazines: Cycloguanil pamoate, Proguanil.

Miscellaneous: Pyrimethamine, Artesunate, Artemether, Atovaquone.

#### Anti-tubercular Agents

Synthetic anti tubercular agents: Isoniazid\*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.\*

Anti tubercular antibiotics: Rifampicin, Rifabutin, Cycloserine Streptomycin, Capreomycin sulphate.

#### Urinary tract anti-infective agents

Quinolones: SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin\*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin

Miscellaneous: Furazolidine, Nitrofurantoin\*, Methanamine.

#### Antiviral agents:

Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir\*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.

Antifungal agents:

Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin.

Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconazole, Miconazole\*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, 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 Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide\*, Sulphapyridine, Sulfamethoxazole\*, Sulphadiazine, Mefenide acetate, Sulfasalazine.

Folate reductase inhibitors: Trimethoprim\*, Cotrimoxazole.

Sulfones: Dapsone\*.

Introduction to Drug Design

Various approaches used in drug design.

Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammett's electronic parameter, Taft's steric parameter and Hansch analysis.

Pharmacophore modeling and docking techniques.

Combinatorial Chemistry: Concept and applications chemistry: solid phase and solution phase synthesis. of combinatorial

16PH3228. MEDICINAL CHEMISTRY- III (Practical)

I Preparation of drugs and intermediates

1 Sulphanilamide

2 7-Hydroxy, 4-methyl coumarin

3 Chlorobutanol

4 Triphenyl imidazole

5 Tolbutamide

6 Hexamine

II Assay of drugs

1 Isonicotinic acid hydrazide

2 Chloroquine

3 Metronidazole

4 Dapsone

5 Chlorpheniramine maleate

6 Benzyl penicillin

III Preparation of medicinally important compounds or intermediates by Microwave irradiation technique

IV Drawing structures and reactions using chem draw®

V Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinski's RO5)

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH3229: PHARMACOLOGY-III	CO1	understand the mechanism of drug action and its relevance in the treatment of different infectious diseases	1,4	1,2

	CO2	comprehend the principles of toxicology and treatment of various poisonings and	1,4	1,2
	CO3	appreciate correlation of pharmacology with related medical sciences.	1,4	1,2
	CO4	To be able to ascertain the pharmacodynamics of medicinal agents	1,4	1,2
	CO5	Perform various invitro experiments to demonstrate receptor actions using isolated tissue preparation	2,4	2,3
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. 3. Chemotherapy a. General principles of chemotherapy. b. Sulfonamides and cotrimoxazole. c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolones, tetracycline and aminoglycosides a. Antitubercular agents b. Antileprotic agents c. Antifungal agents d. Antiviral drugs e. Anthelmintics f. Antimalarial drugs g. Antiamoebic agents 3. Chemotherapy l. Urinary tract infections and sexually transmitted diseases. m. Chemotherapy of malignancy. 4. Immunopharmacology a. Immunostimulants b. Immunosuppressant Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars 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, organophosphorus compound and lead, mercury and arsenic poisoning. 6. Chronopharmacology a. Definition of rhythm and cycles. b. Biological clock and their significance leading to chronotherapy. 16PH3229. PHARMACOLOGY-III (Practical) 1. Dose calculation in pharmacological experiments 2. Antiallergic activity by mast cell stabilization assay 3. Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model.				

4. Study of effect of drugs on gastrointestinal motility
5. Effect of agonist and antagonists on guinea pig ileum
6. Estimation of serum biochemical parameters by using semi- autoanalyser
7. Effect of saline purgative on frog intestine
8. Insulin hypoglycemic effect in rabbit
9. Test for pyrogens ( rabbit method)
10. Determination of acute oral toxicity (LD50) of a drug from a given data
11. Determination of acute skin irritation / corrosion of a test substance
12. Determination of acute eye irritation / corrosion of a test substance
13. Calculation of pharmacokinetic parameters from a given data
14. Biostatistics methods in experimental pharmacology( student's t test, ANOVA)
15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH3230 : HERBAL DRUG TECHNOLOGY	CO1	understand raw material as source of herbal drugs from cultivation to herbal drug product	1,PSO2	1,2
	CO2	know the WHO and ICH guidelines for evaluation of herbal drugs	1,PSO2	1,2
	CO3	know the herbal cosmetics, natural sweeteners, nutraceuticals	1,PSO2	1,2
	CO4	appreciate patenting of herbal drugs, GMP .	1,PSO2	1,2
	CO5	Prepare various herbal formulations	2,PSO1	2,3

Herbs as raw materials

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.

Nutraceuticals

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.

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

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 Z of Drugs & Cosmetics Act for ASU drugs.

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.

16PH3230. HERBAL DRUG TECHNOLOGY (Practical)

1. To perform preliminary phytochemical screening of crude drugs.
2. Determination of the alcohol content of Asava and Arista
3. Evaluation of excipients of natural origin
4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.
5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements.
6. Monograph analysis of herbal drugs from recent Pharmacopoeias
7. Determination of Aldehyde content
8. Determination of Phenol content
9. Determination of total alkaloids

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH3231 : BIOPHARMACEUTICS AND PHARMACOKINETICS	CO1	Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.	2,PSO1	1,2
	CO2	Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.	2,PSO1	1,2
	CO3	To understand the concepts of bioavailability and bioequivalence of drug products and their significance.	2,PSO1	1,2
	CO4	Understand various pharmacokinetic parameters, their significance & applications.	2,PSO1	1,2

Introduction to Biopharmaceutics

Absorption; Mechanisms of drug absorption through GIT, factors influencing drug absorption through GIT, absorption of drug from Non per oral extra-vascular routes, Distribution Tissue permeability of drugs, binding of drugs, apparent, volume of 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

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.

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 -  $KE$ ,  $t_{1/2}$ ,  $V_d$ ,  $AUC$ ,  $K_a$ ,  $Cl_t$  and  $CL_R$ - definitions methods of eliminations, understanding of their significance and application

Multicompartment models: Two compartment open model. IV bolus

Kinetics of multiple dosing, steady state drug levels, calculation of loading and maintenance doses and their significance in clinical settings.

Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing Non-linearity.

c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH3232: PHARMACEUTICAL BIOTECHNOLOGY	CO1	Understanding the importance of Immobilized enzymes in Pharmaceutical Industries	1,4	1,2
	CO2	Genetic engineering applications in relation to production of pharmaceuticals	1,4	1,2
	CO3	Importance of Monoclonal antibodies in Industries	1,4	1,2
	CO4	Appreciate the use of microorganisms in fermentation technology	1,4	1,2
<p>a) Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.</p> <p>b) Enzyme Biotechnology- Methods of enzyme immobilization and applications.</p> <p>c) Biosensors- Working and applications of biosensors in Pharmaceutical Industries.</p> <p>d) Brief introduction to Protein Engineering.</p> <p>e) Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.</p> <p>f) Basic principles of genetic engineering.</p> <p>a) Study of cloning vectors, restriction endonucleases and DNA ligase.</p> <p>b) Recombinant DNA technology. Application of genetic engineering in medicine.</p> <p>c) Application of r DNA technology and genetic engineering in the production of:</p> <p>i) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin.</p> <p>d) Brief introduction to PCR</p> <p>Types of immunity- humoral immunity, cellular immunity</p> <p>a) Structure of Immunoglobulins</p> <p>b) Structure and Function of MHC</p> <p>c) Hypersensitivity reactions, Immune stimulation and Immune suppressions.</p> <p>d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.</p> <p>e) Storage conditions and stability of official vaccines</p> <p>f) Hybridoma technology- Production, Purification and Applications</p> <p>g) Blood products and Plasma Substitutes.</p> <p>a) Immuno blotting techniques- ELISA, Western blotting, Southern blotting.</p> <p>b) Genetic organization of Eukaryotes and Prokaryotes</p> <p>c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.</p> <p>d) Introduction to Microbial biotransformation and applications.</p> <p>e) Mutation: Types of mutation/mutants.</p> <p>a) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.</p> <p>b) Large scale production fermenter design and its various controls.</p> <p>c) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,</p> <p>d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma,</p>				



plasma Substitutes.				
COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH3233: PHARMACEUTICAL QUALITY ASSURANCE	CO1	understand the cGMP aspects in a pharmaceutical industry	1,PSO1	1,2
	CO2	appreciate the importance of documentation	1,PSO1	1,2
	CO3	understand the scope of quality certifications applicable to pharmaceutical industries	1,PSO1	1,2
	CO4	understand the responsibilities of QA & QC departments	1,PSO1	1,2
<p>Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP</p> <p>Total Quality Management (TQM): Definition, elements, philosophies</p> <p>ICH Guidelines: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines</p> <p>Quality by design (QbD): Definition, overview, elements of QbD program, tools ISO 9000 &amp; ISO14000: Overview, Benefits, Elements, steps for registration NABL accreditation : Principles and procedures</p> <p>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.</p> <p>Equipments and raw materials: Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.</p> <p>Quality Control: Quality control test for containers, rubber closures and secondary packing materials.</p> <p>Good Laboratory Practices: General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities</p> <p>Complaints: Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.</p> <p>Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.</p> <p>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.</p> <p>Warehousing: Good warehousing practice, materials management</p>				
COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4134: INSTRUMENTAL METHODS OF ANALYSIS	CO1	Know about various instruments and standard operating procedures	2,4	1,2
	CO2	Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis	2,4	1,2
	CO3	Understand the chromatographic separation and analysis of drugs.	2,4	1,2
	CO4	Understand the principle and application of advanced analytical instruments.	2,4	1,2
	CO5	Perform quantitative & qualitative analysis of drugs using various analytical instruments.	2,4	2,3
<p>UV Visible spectroscopy</p> <p>Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations.</p> <p>Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube,</p>				

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

IR spectroscopy

Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations

Instrumentation - Sources of radiation, wavelength selectors, 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

Nepheloturbidometry- Principle, instrumentation and applications

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

Gas chromatography - Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications

High performance liquid chromatography (HPLC)-Introduction, theory, instrumentation, advantages and applications.

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

16PH4134. INSTRUMENTAL METHODS OF ANALYSIS (Practical)

1 Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds

2 Estimation of dextrose by colorimetry

3 Estimation of sulfanilamide by colorimetry

4 Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy

5 Assay of paracetamol by UV- Spectrophotometry

6 Estimation of quinine sulfate by fluorimetry

7 Study of quenching of fluorescence

8 Determination of sodium by flame photometry

9 Determination of potassium by flame photometry

10 Determination of chlorides and sulphates by nephelo turbidometry

11 Separation of amino acids by paper chromatography

12 Separation of sugars by thin layer chromatography

13 Separation of plant pigments by column chromatography

14 Demonstration experiment on HPLC

15 Demonstration experiment on Gas Chromatography

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4135 : INDUSTRIAL PHARMACYII	CO1	Know the process of pilot plant and scale up of pharmaceutical dosage forms	1,PSO1	1,2

	CO2	Understand the process of technology transfer from lab scale to commercial batch	1,PSO1	1,2
	CO3	Know different Laws and Acts that regulate pharmaceutical industry	1,PSO1	1,2
	CO4	Understand the approval process and regulatory requirements for drug products	1,PSO1	1,2
<p>Pilot plant scale 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</p> <p>Technology development and transfer: WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R &amp; D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, 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</p> <p>Regulatory affairs: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals</p> <p>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.</p> <p>Quality management systems: Quality management &amp; 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</p> <p>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.</p>				
COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4136: PHARMACY PRACTICE	CO1	know various drug distribution methods in a hospital	5,7	1,2
	CO2	appreciate the pharmacy stores management and inventory control	5,7	1,2
	CO3	monitor drug therapy of patient through medication chart review and clinical review	5,7	1,2
	CO4	obtain medication history interview and counsel the patients	5,7	1,2
<p>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.</p> <p>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.</p> <p>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</p>				

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.

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.

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.

Drug information services

Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information.

a) Patient counseling

Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist

b) 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.

c) Prescribed medication order and communication skills

Prescribed medication order- interpretation and legal requirements, and Communication skills-communication with prescribers and patients.

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.

Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern.

c) Over the counter (OTC) sales

Introduction and sale of over the counter, and Rational use of common over the counter medications.

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

a) Investigational use of drugs

Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.

b) Interpretation of Clinical Laboratory Tests

Blood chemistry, hematology, and urinalysis

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4137: NOVEL DRUG DELIVERY SYSTEMS	CO1	Know about current developments in drug delivery technologies	2,PSO2	1,2
	CO2	To understand various approaches for development of novel drug delivery systems.	2,PSO2	1,2
	CO3	To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation	2,PSO2	1,2
	CO4	To be able to design or recommend a drug delivery system	2,PSO2	1,2

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.

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

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

Nasopulmonary drug delivery system: Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers

Targeted drug Delivery: Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications

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

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4239: BIOSTATISTICS AND RESEARCH METHODOLOGY	CO1	Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment)	4,5	1,2
	CO2	Know the various statistical techniques to solve statistical problems	4,5	1,2
	CO3	Appreciate statistical techniques in solving the problems.	4,5	1,2
	CO4	Know the applications of statistics in clinical data management	4,5	1,2

Introduction: Statistics, Biostatistics, Frequency distribution  
Measures of central tendency: Mean, Median, Mode- Pharmaceutical examples Measures of dispersion: Dispersion, Range, standard deviation, Pharmaceutical problems  
Correlation: Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples  
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- Pharmaceutical Examples  
Probability: Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties - problems  
Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples  
Parametric test: t-test(Sample, Pooled or Unpaired and Paired) , ANOVA, (One way and Two way), Least Significance difference  
Non Parametric tests: Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test  
Introduction to Research: Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism  
Graphs: Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph Designing the methodology: Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases.  
Blocking and confounding system for Two-level factorials  
Regression modeling: Hypothesis testing in Simple and Multiple regression models Introduction to Practical components of Industrial and Clinical Trials Problems: Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R - Online Statistical Software's to Industrial and Clinical trial approach  
Design and Analysis of experiments:  
Factorial Design: Definition, 22, 23 design. Advantage of factorial design Response Surface methodology: Central composite design, Historical design, Optimization Techniques

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4240: SOCIAL AND PREVENTIVE PHARMACY	CO1	Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.	7,8	1,2
	CO2	Have a critical way of thinking based on current healthcare development.	7,8	1,2
	CO3	Evaluate alternative ways of solving problems related to health and pharmaceutical issues	7,8	1,2
	CO4	Design a better health care service system	7,8	1,2

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

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

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.

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

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.

<b>COURSE</b>	<b>CO</b>	<b>Course Outcome's</b>	<b>PO/PSO</b>	<b>BTL</b>
16PH4241ET. PHARMA MARKETING MANAGEMENT	CO1	to provide an understanding of sales and marketing of pharmaceutical products.	6,PSO2	1,2
	CO2	Know about various policies for drug inventory management	6,PSO2	1,2
	CO3	Know about retail and wholesale marketing	6,PSO2	1,2
	CO4	Understand business potential and development in product sales and manufacturing	6,PSO2	1,2

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.

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.

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.

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.

Pricing:

Meaning, importance, objectives, 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.

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4242ET: PHARMACEUTICAL REGULATORY SCIENCE	CO1	Know about legal aspects and quality policies for drug manufacturing	1,PSO1	1,2
	CO2	Know about the process of drug discovery and development	1,PSO1	1,2
	CO3	Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals	1,PSO1	1,2
	CO4	Know the regulatory approval process and their registration in Indian and international markets	1,PSO1	1,2

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.

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)

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.

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

Regulatory Concepts

Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4243ET: PHARMACOVIGILANCE	CO1	Why drug safety monitoring is important?	6,PSO2	1,2
	CO2	History and development of pharmacovigilance	6,PSO2	1,2
	CO3	National and international scenario of pharmacovigilance	6,PSO2	1,2
	CO4	Dictionaries, coding and terminologies used in pharmacovigilance	6,PSO2	1,2

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

#### 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 Standardised MedDRA queries
- WHO drug dictionary
- Eudravigilance medicinal product dictionary

#### Information resources in pharmacovigilance

- Basic drug information resources
- Specialised resources for ADRs

#### Establishing pharmacovigilance programme

- Establishing in a hospital
- Establishment & operation of drug safety department in industry
- Contract Research Organisations (CROs)
- Establishing a national programme

#### 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

#### 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
- Pharmacogenomics of adverse drug reactions
- Genetics related ADR with example focusing PK parameters.
- Drug safety evaluation in special population
- Paediatrics
  - Pregnancy and lactation
  - Geriatrics
- CIOMS
- CIOMS Working Groups
  - CIOMS Form
- CDSCO (India) and Pharmacovigilance
- D&C Act and Schedule Y
  - Differences in Indian and global pharmacovigilance requirements.

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4244ET. QUALITY CONTROL AND STANDARDIZATION OF HERBALS	CO1	know WHO guidelines for quality control of herbal drugs	2,PSO1	1,2
	CO2	know Quality assurance in herbal drug industry	2,PSO1	1,2
	CO3	know the regulatory approval process and their registration in Indian and international markets	2,PSO1	1,2
	CO4	appreciate EU and ICH guidelines for quality control of herbal drugs	2,PSO1	1,2

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 for use

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.

EU and ICH guidelines for quality control of herbal drugs.

Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines

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.

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

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4245ET. COMPUTER AIDED DRUG DESIGN	CO1	Design and discovery of lead molecules	3,PSO2	1,2
	CO2	The role of drug design in drug discovery process	3,PSO2	1,2

	CO3	The concept of QSAR and docking	3,PSO2	1,2
	CO4	Various strategies to develop new drug like molecules.	3,PSO2	1,2
<p>Introduction to Drug Discovery and Development</p> <p>Stages of drug discovery and development</p> <p>Lead discovery and Analog Based Drug Design</p> <p>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.</p> <p>Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Any three case studies</p> <p>Quantitative Structure Activity Relationship (QSAR)</p> <p>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, Hammett's substituent constant and Taft's steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.</p> <p>Molecular Modeling and virtual screening techniques</p> <p>Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening,</p> <p>Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening. De novo drug design.</p> <p>Informatics &amp; Methods in drug design</p> <p>Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.</p> <p>Molecular Modeling: Introduction to molecular mechanics and quantum mechanics. Energy Minimization methods and Conformational Analysis, global conformational minima determination.</p>				
COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4246ET: CELL AND MOLECULAR BIOLOGY	CO1	Summarize cell and molecular biology history.	2,4	1,2
	CO2	Summarize cellular functioning and composition.	2,4	1,2
	CO3	Describe the chemical foundations of cell biology.	2,4	1,2
	CO4	Summarize the DNA properties of cell biology.	2,4	1,2
<p>a) Cell and Molecular Biology: Definitions theory and basics and Applications.</p> <p>b) Cell and Molecular Biology: History and Summation.</p> <p>c) Properties of cells and cell membrane.</p> <p>d) Prokaryotic versus Eukaryotic</p> <p>e) Cellular Reproduction</p> <p>f) Chemical Foundations – an Introduction and Reactions (Types)</p> <p>a) DNA and the Flow of Molecular Information</p> <p>b) DNA Functioning</p> <p>c) DNA and RNA</p> <p>d) Types of RNA</p> <p>e) Transcription and Translation</p> <p>a) Proteins: Defined and Amino Acids</p> <p>b) Protein Structure</p> <p>c) Regularities in Protein Pathways</p>				

d)	Cellular Processes			
e)	Positive Control and significance of Protein Synthesis			
a)	Science of Genetics			
b)	Transgenics and Genomic Analysis			
c)	Cell Cycle analysis			
d)	Mitosis and Meiosis			
e)	Cellular Activities and Checkpoints			
a)	Cell Signals: Introduction			
b)	Receptors for Cell Signals			
c)	Signaling Pathways: Overview			
d)	Misregulation of Signaling Pathways			
e)	Protein-Kinases: Functioning			
COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4247ET. COSMETIC SCIENCE	CO1	Principles of formulation and building blocks of skin care products	PSO1,PSO2	1,2
	CO2	Principles of formulation and building blocks of Hair care products	PSO1,PSO2	1,2
	CO3	Role of herbs in cosmetics	PSO1,PSO2	1,2
	CO4	Principles of Cosmetic Evaluation	PSO1,PSO2	1,2
<p>Principles of formulation and building blocks of skin care products:</p> <p>Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmeceuticals. Antiperspirants &amp; deodorants- Actives &amp; mechanism of action.</p> <p>Principles of formulation and building blocks of Hair care products:</p> <p>Conditioning shampoo, Hair conditioner, anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phenylene diamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.</p> <p>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.</p> <p>Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties Soaps, and syndet bars. Evolution and skin benefits.</p> <p>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</p>				
COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4248ET. EXPERIMENTAL	CO1	Appreciate the applications of various commonly used laboratory animals.	2,4	1,2

PHARMACOLOGY	CO2	Appreciate and demonstrate the various screening methods used in preclinical research	2,4	1,2
	CO3	Appreciate and demonstrate the importance of biostatistics and research methodology	2,4	1,2
	CO4	Design and execute a research hypothesis independently	2,4	1,2
	<p>Laboratory Animals: 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.</p> <p>Preclinical screening models a. 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. b. Study of screening animal models for Diuretics, nootropics, anti-Parkinson's, antiasthmatics, Preclinical screening models: for CNS activity- analgesic, antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease</p> <p>Preclinical screening models: for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaesthetics</p> <p>Preclinical screening models: for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslipidemic, anti aggregatory, coagulants, and anticoagulants</p> <p>Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.</p> <p>Research methodology and Bio-statistics 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</p>			
<b>COURSE</b>	<b>CO</b>	<b>Course Outcome's</b>	<b>PO/PSO</b>	<b>BTL</b>
16PH4249ET. ADVANCED INSTRUMENTATION TECHNIQUES	CO1	understand the advanced instruments used and its applications in drug analysis	2,4	1,2
	CO2	understand the chromatographic separation and analysis of drugs.	2,4	1,2
	CO3	understand the calibration of various analytical instruments	2,4	1,2
	CO4	know analysis of drugs using various analytical instruments.	2,4	1,2
<p>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</p> <p>Thermal Methods of Analysis: Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC)</p> <p>X- Ray Diffraction Methods: Origin of X-rays, basic aspects of crystals, X- ray</p>				

Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications.

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

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

Hyphenated techniques-LC-MS/MS, GC-MS/MS, HPTLC-MS

COURSE	CO	Course Outcome's	PO/PSO	BTL
16PH4250ET. DIETARY SUPPLEMENTS AND NUTRACEUTICALS	CO1	Understand the need of supplements by the different group of people to maintain healthy life.	PSO1,PSO2	1,2
	CO2	Understand the outcome of deficiencies in dietary supplements.	PSO1,PSO2	1,2
	CO3	Appreciate the components in dietary supplements and the application.	PSO1,PSO2	1,2
	CO4	Appreciate the regulatory and commercial aspects of dietary supplements including health claims.	PSO1,PSO2	1,2

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

Phytochemicals as nutraceuticals: Occurrence and characteristic features(chemical nature medicinal benefits) of following

- Carotenoids-  $\alpha$  and  $\beta$ -Carotene, Lycopene, Xanthophylls, leutin
- Sulfides: Diallyl sulfides, Allyl trisulfide.
- Polyphenolics: Resveratrol
- Flavonoids- Rutin, Naringin, Quercetin, Anthocyanidins, catechins, Flavones
- Prebiotics / Probiotics.: Fructo oligosaccharides, Lacto bacillum
- Phyto estrogens : Isoflavones, daidzein, Geobustan, lignans
- Tocopherols
- Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.

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..

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,  $\alpha$ - Lipoic acid, melatonin

Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole.

c) Functional foods for chronic disease prevention

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.