ROYAL GLOBAL UNIVERSITY
GUWAHATI

# ROYAL SCHOOL OF PHARMACY
# (RSP)
# (Bachelor of Pharmacy)

# SYLLABUS
# &
# COURSE STRUCTURE

## B.PHARMACY

## B.PHARMACY

## Programme Structure

| 1st Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl.No.** | **Subject Code** | **Names of subjects** | **L** | **T** | **P** | **C** | **TCP** |
| **Core Subjects** | | | | | | | |
| 1 | PHR232C101 / BP101T | Human Anatomy and Physiology I | 3 | 1 | 0 | 4 | 4 |
| 2 | PHR232C102 / BP102T | Pharmaceutical Analysis I | 3 | 1 | 0 | 4 | 4 |
| 3 | PHR232C103 / BP103T | Pharmaceutics I | 3 | 1 | 0 | 4 | 4 |
| 4 | PHR232C104 / BP104T | Pharmaceutical Inorganic Chemistry | 3 | 1 | 0 | 4 | 4 |
| 5 | PHR232C105/ BP105T | Communication Skills I | 1 | 0 | 0 | 1 | 1 |
| 6 | PHR232C106/ BP106RBT | Remedial Biology (Students with PCM in HSC) | 2 | 0 | 0 | 2 | 2 |
| | PHR232C107/ BP106RMT | Remedial Mathematics(Students with PCB in HSC) | 2 | 0 | 0 | 2 | 2 |
| 7 | PHR232C108 | Environmental Sciences I | 1 | 0 | 0 | 1 | 1 |
| 8 | PHR232C111 | Human Anatomy and Physiology I – Practical | 0 | 0 | 4 | 2 | 4 |
| 9 | PHR232C112 | Pharmaceutical Analysis I – Practical | 0 | 0 | 4 | 2 | 4 |
| 10 | PHR232C113 | Pharmaceutics I – Practical | 0 | 0 | 4 | 2 | 4 |
| 11 | PHR232C114 | Pharmaceutical Inorganic Chemistry – Practical | 0 | 0 | 4 | 2 | 4 |
| 12 | PHR232C115 | Communication skills – Practical | 0 | 0 | 2 | 1 | 2 |
| 13 | PHR232C116 | Remedial Biology – Practical | 0 | 0 | 2 | 1 | 2 |
| **Ability Enhancement Compulsory Courses (AECC)** | | | | | | | |
| 14 | CEN982A101 | Communicative English I | 1 | 0 | 0 | 1 | 1 |
| 15 | BHS982A104 | Behavioural Science–I | 1 | 0 | 0 | 1 | 1 |
| | | **TOTAL** | **18** | **4** | **$20^{B}$ $18^{M}$** | **$32^{B}$ $31^{M}$** | **$42^{B}$ $40^{M}$** |

M = Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing For Remedial Mathematics course**.**

B = Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology course**.**

| 2nd Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl.No.** | **Subject Code** | **Names of subjects** | **L** | **T** | **P** | **C** | **TCP** |
| **Core Subjects** | | | | | | | |
| 1 | PHR232C201/ BP201T | Human Anatomy and Physiology II | 3 | 1 | 0 | 4 | 4 |
| 2 | PHR232C202 / BP202T | Pharmaceutical Organic Chemistry I | 3 | 1 | 0 | 4 | 4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | PHR232C203 / BP203T | Biochemistry | 3 | 1 | 0 | 4 | 4 |
| 4 | PHR232C204 / BP204T | Pathophysiology | 3 | 1 | 0 | 4 | 4 |
| 5 | PHR232C205 / BP205T | Computer Applications in Pharmacy | 3 | 0 | 0 | 3 | 3 |
| 6 | PHR232C206 / BP206T | Environmental Sciences II | 2 | 0 | 0 | 2 | 2 |
| 7 | PHR232C207 | Communication Skills II | 1 | 0 | 0 | 1 | 1 |
| 8 | PHR232C211 | Human Anatomy and Physiology II –Practical | 0 | 0 | 4 | 2 | 4 |
| 9 | PHR232C212 | Pharmaceutical Organic Chemistry I– Practical | 0 | 0 | 4 | 2 | 4 |
| 10 | PHR232C213 | Biochemistry – Practical | 0 | 0 | 4 | 2 | 4 |
| 11 | PHR232C214 | Computer Applications in Pharmacy – Practical | 0 | 0 | 2 | 1 | 2 |
| **Ability Enhancement Compulsory Courses (AECC)** | | | | | | | |
| 12 | CEN982A201 | Communicative English II | 1 | 0 | 0 | 1 | 1 |
| 13 | BHS982A204 | Behavioural Science–II | 1 | 0 | 0 | 1 | 1 |
| | | **TOTAL** | **20** | **4** | **14** | **31** | **38** |

| **3rd Semester** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl.No.** | **Subject Code** | **Names of subjects** | **L** | **T** | **P** | **C** | **TCP** |
| **Core Subjects** | | | | | | | |
| 1 | PHR232C301 / BP301T | Pharmaceutical Organic Chemistry II | 3 | 1 | 0 | 4 | 4 |
| 2 | PHR232C302 / BP302T | Physical Pharmaceutics I | 3 | 1 | 0 | 4 | 4 |
| 3 | PHR232C303 / BP303T | Pharmaceutical Microbiology | 3 | 1 | 0 | 4 | 4 |
| 4 | PHR232C304 / BP304T | Pharmaceutical Engineering | 3 | 1 | 0 | 4 | 4 |
| 5 | PHR232C311 | Pharmaceutical Organic Chemistry II – Practical | 0 | 0 | 4 | 2 | 4 |
| 6 | PHR232C312 | Physical Pharmaceutics I – Practical | 0 | 0 | 4 | 2 | 4 |
| 7 | PHR232C313 | Pharmaceutical Microbiology – Practical | 0 | 0 | 4 | 2 | 4 |
| 8 | PHR232C314 | Pharmaceutical Engineering –Practical | 0 | 0 | 4 | 2 | 4 |
| **Ability Enhancement Compulsory Courses (AECC)** | | | | | | | |
| 9 | CEN982A301 | Communicative English III | 1 | 0 | 0 | 1 | 1 |
| **Ability Enhancement Elective Courses (AEEC)** | | | | | | | |
| 10 | | **AEEC 1** | 2 | 0 | 0 | 2 | 2 |
| **Generic Elective** | | | | | | | |
| 11 | | GE1 | 3 | 0 | 0 | 3 | 3 |
| | | **TOTAL** | **18** | **4** | **16** | **30** | **38** |

| **4th Semester** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl.No.** | **Subject Code** | **Names of subjects** | **L** | **T** | **P** | **C** | **TCP** |
| **Core Subjects** | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | PHR232C401 / BP401T | Pharmaceutical Organic Chemistry III | 3 | 1 | 0 | 4 | 4 |
| 2 | PHR232C402 / BP402T | Medicinal Chemistry I | 3 | 1 | 0 | 4 | 4 |
| 3 | PHR232C403 / BP403T | Physical Pharmaceutics II | 3 | 1 | 0 | 4 | 4 |
| 4 | PHR232C404 / BP404T | Pharmacology I | 3 | 1 | 0 | 4 | 4 |
| 5 | PHR232C405 / BP405T | Pharmacognosy and Phytochemistry I | 3 | 1 | 0 | 4 | 4 |
| 6 | PHR232C412 | Medicinal Chemistry I– Practical | 0 | 0 | 4 | 2 | 4 |
| 7 | PHR232C413 | Physical Pharmaceutics II– Practical | 0 | 0 | 4 | 2 | 4 |
| 8 | PHR232C414 | Pharmacology I– Practical | 0 | 0 | 4 | 2 | 4 |
| 9 | PHR232C415 | Pharmacognosy and Phytochemistry I– Practical | 0 | 0 | 4 | 2 | 4 |
| **Ability Enhancement Compulsory Courses (AECC)** | | | | | | | |
| 10 | CEN982A401 | Communicative English IV | 1 | 0 | 0 | 1 | 1 |
| **Ability Enhancement Elective Courses (AEEC)** | | | | | | | |
| 11 | | **AEEC 2** | 2 | 0 | 0 | 2 | 2 |
| **Generic Elective** | | | | | | | |
| 12 | | GE 2 | 3 | 0 | 0 | 3 | 3 |
| | | **TOTAL** | **21** | **5** | **16** | **34** | **42** |

| **5th Semester** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl.No.** | **Subject Code** | **Names of subjects** | **L** | **T** | **P** | **C** | **TCP** |
| **Core Subjects** | | | | | | | |
| 1 | PHR232C501 / BP501T | Medicinal Chemistry II | 3 | 1 | 0 | 4 | 4 |
| 2 | PHR232C502 / BP502T | Industrial Pharmacy I | 3 | 1 | 0 | 4 | 4 |
| 3 | PHR232C503 / BP503T | Pharmacology II | 3 | 1 | 0 | 4 | 4 |
| 4 | PHR232C504 / BP504T | Pharmacognosy and Phytochemistry II | 3 | 1 | 0 | 4 | 4 |
| 5 | PHR232C505 / BP505T | Pharmaceutical Jurisprudence | 3 | 1 | 0 | 4 | 4 |
| 6 | PHR232C511 | Industrial Pharmacy I– Practical | 0 | 0 | 4 | 2 | 4 |
| 7 | PHR232C512 | Pharmacology II– Practical | 0 | 0 | 4 | 2 | 4 |
| 8 | PHR232C513 | Pharmacognosy and Phytochemistry II– Practical | 0 | 0 | 4 | 2 | 4 |
| **Ability Enhancement Compulsory Courses (AECC)** | | | | | | | |
| 9 | CEN982A501 | Communicative English V | 1 | 0 | 0 | 1 | 1 |
| **Generic Elective** | | | | | | | |
| 10 | | GE 3 | 3 | 0 | 0 | 3 | 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **TOTAL** | **19** | **5** | **12** | **30** | **36** |

| **6th Semester** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl.No.** | **Subject Code** | **Names of subjects** | **L** | **T** | **P** | **C** | **TCP** |
| **Core Subjects** | | | | | | | |
| 1 | PHR232C601 / BP601T | Medicinal Chemistry III | 3 | 1 | 0 | 4 | 4 |
| 2 | PHR232C602 / BP602T | Pharmacology III | 3 | 1 | 0 | 4 | 4 |
| 3 | PHR232C603 / BP603T | Herbal Drug Technology | 3 | 1 | 0 | 4 | 4 |
| 4 | PHR232C604 / BP604T | Biopharmaceutics and Pharmacokinetics | 3 | 1 | 0 | 4 | 4 |
| 5 | PHR232C605 / BP605T | Pharmaceutical Biotechnology | 3 | 1 | 0 | 4 | 4 |
| 6 | PHR232C606 / BP606T | Quality Assurance | 3 | 1 | 0 | 4 | 4 |
| 7 | PHR232C611 | Medicinal Chemistry III– Practical | 0 | 0 | 4 | 2 | 4 |
| 8 | PHR232C612 | Pharmacology III– Practical | 0 | 0 | 4 | 2 | 4 |
| 9 | PHR232C613 | Herbal Drug Technology– Practical | 0 | 0 | 4 | 2 | 4 |
| **Ability Enhancement Compulsory Courses (AECC)** | | | | | | | |
| 10 | CEN982A601 | Communicative English-VI | 1 | 0 | 0 | 1 | 1 |
| **Generic Elective** | | | | | | | |
| 11 | | GE 4 | 3 | 0 | 0 | 3 | 3 |
| | | **TOTAL** | **22** | **6** | **12** | **34** | **40** |

| **7th semester** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl.No.** | **Subject Code** | **Names of subjects** | **L** | **T** | **P** | **C** | **TCP** |
| **Core Subjects** | | | | | | | |
| 1 | PHR232C701 / BP701T | Instrumental Methods of Analysis | 3 | 1 | 0 | 4 | 4 |
| 2 | PHR232C702 / BP702T | Industrial Pharmacy II | 3 | 1 | 0 | 4 | 4 |
| 3 | PHR232C703 / BP703T | Pharmacy Practice | 3 | 1 | 0 | 4 | 4 |
| 4 | PHR232C704 / BP704T | Novel Drug Delivery System | 3 | 1 | 0 | 4 | 4 |
| 5 | PHR232S711 / BP706PS | Practice School | 12 | 0 | 0 | 6 | 12 |
| 6 | PHR232C711 | Instrumental Methods of Analysis – Practical | 0 | 0 | 4 | 2 | 4 |
| **Ability Enhancement Compulsory Courses (AECC)** | | | | | | | |
| 7 | CEN982A701 | Communicative English-VII | 1 | - | - | 1 | 1 |
| | | **TOTAL** | **25** | **4** | **4** | **25** | **33** |

| **8th semester** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl.No.** | **Subject Code** | **Names of subjects** | **L** | **T** | **P** | **C** | **TCP** |
| **Core Subjects** | | | | | | | |
| 1 | PHR232C801/ | Biostatistics and Research Methodology | 3 | 1 | - | 4 | 4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | BP801T | | | | | | |
| 2 | PHR232C802/ BP802T | Social and Preventive Pharmacy | 3 | 1 | - | 4 | 4 |
| 3 | PHR232C803/ BP813PW | Project Work | 12 | - | - | 6 | 12 |
| **Ability Enhancement Compulsory Courses (AECC)** | | | | | | | |
| 4 | CEN982A801 | Communicative English-VIII | 1 | - | - | 1 | 1 |
| **DSE Subjects (Any two)** | | | | | | | |
| 5 | PHR232D801 / BP808ET | Cell and Molecular Biology | 3 | 1 | 0 | 4 | 4 |
| 6 | PHR232D802 / BP809ET | Cosmetic Science | 3 | 1 | 0 | 4 | 4 |
| 7 | PHR232D803 / BP810ET | Experimental Pharmacology | 3 | 1 | 0 | 4 | 4 |
| 8 | PHR232D804 / BP811ET | Advanced Instrumentation Techniques | 3 | 1 | 0 | 4 | 4 |
| 9 | PHR232D805 / BP812ET | Dietary Supplements and Nutraceuticals | 3 | 1 | 0 | 4 | 4 |
| 10 | PHR232D801 / BP803ET | Pharma Marketing Management | 3 | 1 | 0 | 4 | 4 |
| 11 | PHR232D802 / BP804ET | Pharmaceutical Regulatory Science | 3 | 1 | 0 | 4 | 4 |
| 12 | PHR232D803 / BP805ET | Pharmacovigilance | 3 | 1 | 0 | 4 | 4 |
| 13 | PHR232D804 / BP806ET | Quality Control and Standardization of Herbals | 3 | 1 | 0 | 4 | 4 |
| 14 | PHR232D805 / BP807ET | Computer Aided Drug Design | 3 | 1 | 0 | 4 | 4 |
| | | **TOTAL** | **25** | **4** | **0** | **23** | **29** |

* 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 fromtime to time.
$Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing ForRemedialMathematics course**.**
#Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology course**.**

**COURSE STRUCTURE FOR B. Pharmacy**

| SEMESTER | CORE COURSE | Credit | Ability Enhancement Compulsory Course (AECC) | Credit | Ability Enhancement Elective Course (AEEC) (Skill Based) | Credit | Elective: Discipline Specific DSE | Credit | Elective: Generic (GE) | Credit | No of papers each semester | TOTAL CREDIT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | Human Anatomy and Physiology I | 6 | Comm. English – I | 1 | Nil | Nil | Nil | Nil | Nil | Nil | 08 | $32^{B}$ $31^{M}$ |
| | Pharmaceutical Analysis I | 6 | Behavioural Science-I * | 1 | | | | | | | | |
| | Pharmaceutics I | 6 | | | | | | | | | | |
| | Pharmaceutical Inorganic Chemistry | 6 | | | | | | | | | | |
| | Communication Skills | 3 | | | | | | | | | | |
| | Remedial Biology (Students with PCM in HSC) | 3 | | | | | | | | | | |
| | Remedial Mathematics( Students with PCB in HSC) | 2 | | | | | | | | | | |
| | Environmental Sciences | 1 | | | | | | | | | | |
| II | Human Anatomy and Physiology II | 6 | Comm. English – II | 1 | Nil | Nil | Nil | Nil | Nil | Nil | 8 | 31 |
| | Pharmaceutical Organic Chemistry I | 6 | Behavioural Science-II * | 1 | | | | | | | | |
| | Biochemistry | 6 | | | | | | | | | | |
| | Pathophysiology | 4 | | | | | | | | | | |
| | Computer Applications in Pharmacy | 4 | | | | | | | | | | |
| | Environmental Sciences | 2 | | | | | | | | | | |
| | Communication Skills | 1 | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| III | Pharmaceutical Organic Chemistry II | 6 | Comm. English-III | 1 | **AEEC 1** | 2 | Nil | Nil | GE1 | 3 | 8 | 30 |
| | Physical Pharmaceutics I | 6 | | | | | | | | | | |
| | Pharmaceutical Microbiology | 6 | | | | | | | | | | |
| | Pharmaceutical Engineering | 6 | | | | | | | | | | |
| IV | Pharmaceutical Organic Chemistry III | 4 | Communicative English IV | 1 | AEEC 2 | 2 | Nil | Nil | GE2 | 3 | 8 | 34 |
| | Medicinal Chemistry I | 6 | | | | | | | | | | |
| | Physical Pharmaceutics II | 6 | | | | | | | | | | |
| | Pharmacology I | 6 | | | | | | | | | | |
| | Pharmacognosy and Phytochemistry I | 6 | | | | | | | | | | |
| V | Medicinal Chemistry II | 4 | Communicative English V | 1 | Nil | Nil | Nil | Nil | GE3 | 3 | 7 | 30 |
| | Industrial Pharmacy I | 6 | | | | | | | | | | |
| | Pharmacology II | 6 | | | | | | | | | | |
| | Pharmacognosy and Phytochemistry II | 6 | | | | | | | | | | |
| | Pharmaceutical Jurisprudence | 4 | | | | | | | | | | |
| VI | Medicinal Chemistry III | 6 | Communicative English-VI | 1 | Nil | Nil | Nil | Nil | GE4 | 3 | 8 | 34 |
| | Pharmacology III | 6 | | | | | | | | | | |
| | Herbal Drug Technology | 6 | | | | | | | | | | |
| | Biopharmaceutics and Pharmacokinetics | 4 | | | | | | | | | | |
| | Pharmaceutical Biotechnology | 4 | | | | | | | | | | |
| | Quality Assurance | 4 | | | | | | | | | | |
| VII | Instrumental Methods of Analysis | 6 | Communicative English-VII | 1 | Nil | Nil | Nil | Nil | Nil | Nil | 6 | 25 |
| | Industrial | 4 | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pharmacy II | | | | | | | | | | | |
| | Pharmacy Practice | 4 | | | | | | | | | | |
| | Novel Drug Delivery System | 4 | | | | | | | | | | |
| | Practice School | 6 | | | | | | | | | | |
| VIII | Biostatistics and Research Methodology | 4 | Communicative English-VIII | 1 | | | DSE 1 | 4 | Nil | Nil | 7 | 23 |
| | Social and Preventive Pharmacy | 4 | | | | | DSE 2 | 4 | | | | |
| | Project Work | 6 | | | | | | | | | | |
| **Total** | | | | | | | | | | | | **$239^{B}$ $238^{M}$** |

**Total Credits: $239^{B}$ / $238^{M}$**

## Scheme of Evaluation

**Theory Papers (T):**

- **Internal assessment 25%**
- **End Term Examination: 75%**

**Practical Papers (P):**

- **Internal assessment 30%**
- **End term examination: 70 %**

# SYLLABUS I SEMESTER

**Paper I/Subject Name: HUMAN ANATOMY AND PHYSIOLOGY-I (THEORY)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:** This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

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

1. Explain the gross morphology, structure and functions of various organs of the human body.
2. Describe the various homeostatic mechanisms and their imbalances.
3. Identify the various tissues and organs of different systems of human body.
4. Perform the various experiments related to special senses and nervous system.
5. Appreciate coordinated working pattern of different organs of each system

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **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.<br>**Cellular level of organization:** Structure and functions of cell, transportacross cell membrane, cell division, cell junctions. General principles of cell communication,intracellular signaling pathway activation by extracellular signalmolecule, Forms of intracellular signaling: a) Contact-dependent b)Paracrine c) Synaptic d) Endocrine<br>**Tissue level of organization:** Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues. | **10 hr** |
| **II.** | **Integumentary system:** Structure and functions of skin<br>**Skeletal system:**Divisions of skeletal system, types of bone, salient features and functionsof bones of axial and appendicular skeletal system<br>Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction<br>**Joints:**Structural and functional classification, types of joints movements and itsarticulation. | **10 hr** |
| **III.** | **Body fluids and blood:**Body fluids, composition and functions of blood, hemopoeisis, formation ofhemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors,transfusion, its significance and disorders of blood, Reticulo endothelial system.<br>**Lymphatic system:**Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions oflymphatic system | **10 Hr** |
| **IV** | **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.<br>**Special senses:**Structure and functions of eye, ear, nose and tongue and their disorders.<br>**Cardiovascular system:**Heart – anatomy of heart, blood circulation, blood vessels, structure and functions ofartery, vein and capillaries, elements of conduction system of heart and heart beat, itsregulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation ofblood pressure, pulse, electrocardiogram and disorders of heart. | **15 hr** |
| **TOTAL** | | **45 hours** |

**HUMAN ANATOMY AND PHYSIOLOGY-I (Practical)**
**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | 1. Study of compound microscope.<br>2. Microscopic study of epithelial and connective tissue<br>3. Microscopic study of muscular and nervous tissue | **4hr/wk** |
| **II.** | 4. Identification of axial bones<br>5. Identification of appendicular bones<br>6. Introduction to hemocytometry.<br>7. Enumeration of white blood cell (WBC) count | **4 hr/wk** |
| **III.** | 8. Enumeration of total red blood corpuscles (RBC) count<br>9. Determination of bleeding time<br>10. Determination of clotting time<br>11. Estimation of hemoglobin content | **4 hr/wk** |
| **IV** | 12. Determination of blood group.<br>13. Determination of erythrocyte sedimentation rate (ESR).<br>14. Determination of heart rate and pulse rate.<br>15. Recording of blood pressure. | **4 hr/wk** |
| **TOTAL** | | **60hours** |

**Text Book:**

1. Sembulingam, K., Sembulingam, P. (2012). Essentials of Medical Physiology, 6th Edition, New Delhi: Jaypee brothers medical publishers.
2. Wilson, J.W., Livingstone, K. C. (1987). Anatomy and Physiology in Health and Illness, 6th Revised Edition, New York: Churchill Livingstone.
3. Tandon, O.P., Tripathi, R. (2011). Best and Tailor's Physiological basis of Medical Practice, 13th Edition, USA: Williams & Wilkins
4. Arthur, C. Guyton., Hall, E. J. (2011). Text book of Medical Physiology, 12th Edition, USA: Elseviers.
5. Grabowski, T., Palmetto, G. A. (2014). Principles of Anatomy and Physiology, 14th Edition, USA: Wiley inter-science.
6. Singh, I. (2011). Textbook of Human Histology, 6th Edition, New Delhi: Jaypee brother's medical publishers.
7. Ghai, C.L.(2013). Textbook of Practical Physiology, 8th Edition, New Delhi: Jaypee brother's medical publishers.

**Reference Books:**

1. Tandon, O.P., Tripathi, R. (2011). Best and Tailor's Physiological basis of Medical Practice. 13th Edition. USA: Williams & Wilkins
2. Arthur, C. Guyton., Hall, E. J. (2011). Text book of Medical Physiology. 12th Edition. USA: Elsevier's.
3. Chatterrje, C. C. (2017). Human Physiology. 11th Edition. Kolkata: Academic Publishers.

## Teaching Learning Process and Assessment Methods

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to explain the gross morphology, structure and functions of various organs of the human body. | Traditional chalk and board teaching and presentations,hands-on- Microscopic study of epithelial and connective tissue, muscular and nervous tissue. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |

| | | | |
|---|---|---|---|
| II. | Describe the various homeostatic mechanisms and their imbalances. | Traditional chalk and board teaching, power point presentations, laboratory based identification | MCQs, regular discussions Test on structure and functions of the organ system |
| III | Students will be able to explain the gross morphology, structure and functions of various organs of the human body. | Traditional teaching and regular discussions and power point presentation on blood and other body fluids | Test and MCQ , assignments. |
| IV | Students will be able to identify the various tissues and organs of different systems of human body and appreciate coordinated working pattern of different organs of each system | Class conduction using board and power point presentation. | Test and MCQ , assignments. |

**Paper II/Subject Name: PHARMACEUTICAL ANALYSIS (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective**: This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs

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

1. Understand the principles of volumetric and electro chemical analysis
2. Carryout various volumetric and electrochemical titrations
3. Develop analytical skills
4. Understand the principle and applications of different electrochemical methods of analysis**.**

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **(a) Pharmaceutical analysis**- Definition and scope<br>i) Different techniques of analysis<br>ii) Methods of expressing concentration<br>iii) Primary and secondary standards.<br>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<br>**(b)Errors:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures<br>(c)Pharmacopoeia, Sources of impurities in medicinal agents,limit tests. | **10 hours** |
| **II.** | **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<br>**Non aqueous titration**: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl | **10 hours** |
| **III.** | **Precipitation titrations**: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.<br>**Complexometric titration**: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.<br>**Gravimetry**: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.<br>Basic Principles,methods and application of diazotisation titration. | **10 hours** |
| **IV** | **Redox titrations**<br>(a) Concepts of oxidation and reduction<br>(b) Types of redox titrations (Principles and applications)<br>Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate<br>**Electrochemical methods of analysis**<br>**Conductometry**- Introduction, Conductivity cell, Conductometric titrations, applications.<br>**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.<br>**Polarography -** Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum<br>electrode, applications | **15 hours** |
| **TOTAL** | | **45 hours** |

**PHARMACEUTICAL ANALYSIS (Practical)**

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Limit Test of the following**<br>(1) Chloride<br>(2) Sulphate<br>(3) Iron<br>(4) Arsenic | **4 Hours / Week** |
| **II.** | **Preparation and standardization of**<br>(1) Sodium hydroxide<br>(2) Sulphuric acid<br>(3) Sodium thiosulfate<br>(4) Potassium permanganate<br>(5) Ceric ammonium sulphate | **4 Hours / Week** |
| **III.** | **Assay of the following compounds along with Standardization of Titrant**<br>(1) Ammonium chloride by acid base titration<br>(2) Ferrous sulphate by Cerimetry<br>(3) Copper sulphate by Iodometry<br>(4) Calcium gluconate by complexometry<br>(5) Hydrogen peroxide by Permanganometry<br>(6) Sodium benzoate by non-aqueous titration<br>(7) Sodium Chloride by precipitation titration | **4 Hours / Week** |
| **IV** | **Determination of Normality by electro-analytical methods**<br>(1) Conductometric titration of strong acid against strong base<br>(2) Conductometric titration of strong acid and weak acid against strong base<br>(3) Potentiometric titration of strong acid against strong base | **4 Hours / Week** |
| **TOTAL** | | **60 hr** |

**Text Book:**

1. Beckett , A.H., Stenlake's, J.B. (2006). Pharmaceutical Chemistry Vol I & II, 4th Edition, UK: Stallone Press of University of London.
2. Vogel, A. I. (2009). Text Book of Quantitative Inorganic analysis, 6th Edition, New Delhi: Pearson.
3. Qadry, J. S., Qadry, S. Z. (2017). Inorganic Pharmaceutical Chemistry, 11th Edition, New Delhi: Atithi Books.

**Reference Book:**

1. Ali, M. (2013). Text Book Pharmaceutical Chemistry-I (Inorganic), 3rd Edition. New Delhi: CBS Publishers.
2. Indian Pharmacopoeia (2018). 8th Edition, MH&FW, Govt. of India.

## Teaching learning process and assessment

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Understand the principles of volumetric and electro chemical analysis | Traditional chalk and board teaching and power point presentations, discussions | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |

| | | | |
|---|---|---|---|
| II. | Students will be able to carryout various volumetric and electrochemical titrations | Traditional chalk and board teaching, power point presentations, laboratory tests | MCQs, regular discussions Tests |
| III | Students will develop Develop analytical skills | Traditional teaching and regular discussions and power point presentations and laboratory tests | Test and MCQ , assignments. |
| IV | Understand the principle and applications of different electrochemical methods of analysis**.** | Class conduction using board and power point presentation, laboratory tests | Regular class Tests and quizzes and assignments. |

**Paper III/Subject Name: PHARMACEUTICS- I (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:** This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.

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

1. Know the history of profession of pharmacy
2. Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
3. Understand the professional way of handling the prescription
4. Preparation of various conventional dosage forms

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **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.<br>**Dosage forms:** Introduction to dosage forms, classification and definitions<br>**Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription.<br>**Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area. | **10 hours** |
| **II.** | **Pharmaceutical calculations**: Weights and measures – Imperial & Metric System, Calculations involving percentage solutions, aligation, proof spirit and isotonic solutions based on freezing point and molecular weight.<br>**Powders:** Definition, classification, advantages and disadvantages,Simple& compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.<br>**Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques | **10 hours** |
| **III.** | **Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.<br>**Biphasic liquids:**<br>**Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.<br>**Emulsions:** Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome. | **8 hours** |
| **IV.** | **Suppositories**: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.<br>**Pharmaceutical incompatibilities**: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.<br>**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 | **15 hours** |
| **Total** | | **43 hours** |

**PHARMACEUTICS- I (Practical)**
**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Syrups**<br>a) Syrup IP'66, b) Compound syrup of Ferrous Phosphate BPC'68<br>**Elixirs**<br>a) Piperazine citrate elixir, b) Paracetamol pediatric elixir<br>**Linctus**<br>a) Terpin Hydrate Linctus IP'66, b) Iodine Throat Paint (Mandles Paint) | **4 hr/wk** |
| **II.** | **Solutions:**<br>a) Strong solution of ammonium acetate, b) Cresol with soap solution<br>c) Lugol's solution<br>**Suspensions**<br>a) Calamine lotion, b) Magnesium Hydroxide mixture, c) Aluminimum Hydroxide gel<br>**Emulsions**<br>a) Turpentine Liniment, b) Liquid paraffin emulsion | **4 hr/wk** |
| **III.** | **Powders and Granules**<br>a) ORS powder (WHO), b) Effervescent granules, c)Dusting powder<br>d)Divded powders<br>**Suppositories**<br>a) Glycerogelatin suppository, b) Coca butter suppository, c) Zinc Oxide suppository | **4 hr/wk** |
| **IV** | **Semisolids**<br>a) Sulphur ointment, b) Non staining-iodine ointment with methyl salicylate<br>c) Carbopal gel<br>**Gargles and Mouthwashes**<br>a) Iodine gargle, b) Chlorhexidine mouthwash | **4 hr/wk** |
| **TOTAL** | | **60 hr** |

**Text Book:**

1. Ansel, H. C. (2010). Pharmaceutical Dosage Form and Drug Delivery System, 9th Edition, New Delhi: Lippincott Williams and Walkins.
2. Carter, S. J. (2008). Cooper and Gunn's Dispensing for Pharmaceutical Students, 12th Edition, New Delhi: CBS publishers.
3. Aulton, M.E. (2001), Pharmaceutics, The Science& Dosage Form Design, 2nd Edition, Edinburgh: Churchill Livingstone.
6. Khar, R.K., Vyas, S.P., Farhan, J.A., Gaurav, K.J. (2014). Lachmann & Libermman Theory and Practice of Industrial Pharmacy, 4th Edition, Michigan: Lea & Febiger Publisher.
7. Remington, A. R. (2005). The Science and Practice of Pharmacy, 21st Edition, New Delhi: Lippincott Williams and Wilkins.
8. Carter, S.J. (2005). Cooper and Gunn's Tutorial Pharmacy, 6th Edition, New Delhi: CBS Publishers.
9. Rawlins, E.A. (2010). Bentley's Text Book of Pharmaceutics, 8th Edition, USA: English Language Book Society, Elsevier Health Sciences.

**Reference Book:**

1. Sellassie, I. G. (1981). Pharmaceutical Pelletization Technology. 1st Edition. New York: Marcel Dekker.
2. Parikh D. M. (1999). Handbook of Pharmaceutical Granulation Technology, 1st Edition: New York: Marcel Dekker.
3. Nieloud, F. & Gilberte, M. M. (1977). Pharmaceutical Emulsions and Suspensions. 1st Edition. New York: Marcel Dekker.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will learn about the history of profession of pharmacy, pharmacopeia, conventional dosage forms etc. | An appropriate blend of chalk board as well as Power point presentations will be adopted, practical demonstrations will also be given | Assignments will be Conducted along with regular tests. |
| II. | Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations | Students will be taught by using of traditional chalk board and demonstrations by showing pictures of dosage form. | Quiz will be organized. They will be shown various pictures to identify the liquid dosage forms. Assignment and tests. |
| III. | Understand the professional way of handling the prescription | Will be taught by chalk and board method. Students will be shown various power point presentations for concept building | They will be asked for examples from regularly used products. Assignment and tests will be conducted. |
| IV. | Students will gain knowledge about suppositories and other semi solid dosage form. | Teaching will be imparted by chalk and board method . laboratory Preparation of the product will also be conducted | Students will given assignments and tests. |

| **Paper IV/Subject Name: PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)** | | |
|---|---|---|
| **L-T-P-C – 3-1-2-6** | **Credit Units: 6** | **Scheme of Evaluation: (T/P/TP)** |

**Objective**: This subject deals with the monographs of inorganic drugs and pharmaceuticals.

**Course Outcome**: Upon completion of course student shall be able to

1. Know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
2. Understand the medicinal and pharmaceutical importance of inorganic compounds like electrolytes and dental products.
3. Understand the medicinal and pharmaceutical importance of inorganic compounds like antacid, antimicrobials.
4. Understand the medicinal and pharmaceutical importance of inorganic compounds like radiopharmaceuticals, emetic etc.

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **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<br>**General methods of preparation**, assay for the compounds superscripted with **asterisk (*),** properties and medicinal uses of inorganic compounds belonging to the following classes | **10 hours** |
| **II.** | **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.<br>**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.<br>**Dental products**: Dentifrices, role of fluoride in the treatment of dental Caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement. | **10 hours** |
| **III.** | **Gastrointestinal agents Acidifiers:** Ammonium chloride* and Dil. HCl<br>**Antacid:** Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture<br>**Cathartics:** Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite<br>**Antimicrobials**: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations | **10 hours** |

| | | |
|---|---|---|
| IV | **Miscellaneous compounds Expectorants:** Potassium iodide, Ammonium chloride*.<br>**Emetics**: Copper sulphate*, Sodium potassium tartarate<br>**Haematinics:** Ferrous sulphate*, Ferrous gluconate<br>**Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite333<br>**Astringents**: Zinc Sulphate, Potash Alum<br>**Radiopharmaceuticals**: Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances. | **15 hours** |
| **TOTAL** | | **45 hours** |

**PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)**

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Limit tests for following ions**<br>Limit test for Chlorides and Sulphates<br>Modified limit test for Chlorides and Sulphates<br>Limit test for Iron<br>Limit test for Heavy metals<br>Limit test for Lead<br>Limit test for Arsenic | **4hr/wk** |
| **II.** | **Identification test**<br>Magnesium hydroxide<br>Ferrous sulphate<br>Sodium bicarbonate<br>Calcium gluconate<br>Copper sulphate | **4hr/wk** |
| **III.** | **Test for purity**<br>Swelling power of Bentonite<br>Neutralizing capacity of aluminum hydroxide gel<br>Determination of potassium iodate and iodine in potassium Iodide | **4hr/wk** |
| **IV** | **Preparation of inorganic pharmaceuticals**<br>Boric acid<br>Potash alum<br>Ferrous sulphate | **4hr/wk** |
| **TOTAL** | | **60 hr** |

**Text Book:**

1. Beckett, A. H., Stenlake's, J. B. (2006). Practical Pharmaceutical Chemistry Vol I & II, 4th Edition, UK: Stalone Press of University.
2. Vogel, A. I. (2009). Text Book of Quantitative Inorganic analysis, 6th Edition, New Delhi: Pearson.
3. Chatwal, G.R. (2012). Inorganic Pharmaceutical Chemistry, 3rd Edition, New Delhi, Himalaya Publishing house.
4. Shroff , M.L. (1968). Inorganic Pharmaceutical Chemistry, 1st Edition.

**Reference Books:**

5. Bentley and Driver's (1960). Textbook of Pharmaceutical Chemistry. 7th Edition, New Delhi: Aithi Medical Books.
6. Anand & Chatwal (2010). Inorganic Pharmaceutical Chemistry, 1st Edition, New Delhi, Himalaya publishers.
7. Indian Pharmacopoeia (2018). 8th Edition, MH&FW, Govt. of India.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will learn the about Impurities in pharmaceutical substances and assay performance | Traditional chalk and black board method, presentation. Class room discussion | Assignment, unit -test and practical assessment through experiments |
| II. | Students will learn buffers, electrolytes and dental products etc | Traditional chalk and black board method with examples and reactions and experiments | MCQ based assignments, unit –test and practical assessment through experiment |
| III | Introduction to gastrointestinal acidifiers and antacids, cathartics and also antimicrobial sustances | Traditional chalk and black board method and presentations | MCQ based assignments, unit –test and practical assessment through experiment |
| IV | Students will be able to learn about radiopharmaceuticals, Poison and Antidote etc | Traditional chalk and black board method and presentations , demonstrations with examples. | MCQ based assignments, unit –test |

| Paper V/Subject Name: COMMUNICATION SKILLS I (Theory) | | |
|---|---|---|
| **L-T-P-C – 1-0-1-2** | **Credit Units: 2** | **Scheme of Evaluation: (T/P/TP)** |

**Obective:** This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.

**Course Outcome**: Upon completion of the course the student shall be able to
1. Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation
2. Communicate effectively (Verbal and Non Verbal)
3. Effectively manage the team as a team player
4. Develop communication skills
5. Develop Leadership qualities and essentials

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context<br>**Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers | **07 Hours** |
| **II.** | **Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment | **03 Hours** |
| **III.** | **Elements of Communication:** Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication | **03 Hours** |
| **IV** | **Communication Styles:** Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style. | **03 Hours** |
| **TOTAL** | | **16 Hours** |

**COMMUNICATION SKILLS I (Practical)**

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Basic communication covering the following topics**<br>Meeting People<br>Asking Questions<br>Making Friends<br>What did you do?<br>Do's and Dont's | **2 hr/week** |
| **II.** | **Pronunciations covering the following topics**<br>Pronunciation (Consonant Sounds)<br>Pronunciation and Nouns<br>Pronunciation (Vowel Sounds) | **2 hr/wk** |

| | | |
|---|---|---|
| **III.** | **Advanced Learning**<br>Listening Comprehension / Direct and Indirect Speech<br>Figures of Speech<br>Effective Communication<br>Writing Skills<br>Effective Writing | **2 hr/wk** |
| **IV** | Interview Handling Skills<br>E-Mail etiquette<br>Presentation Skills | **2 hr/wk** |
| **TOTAL** | | **24 hr** |

**Text Book: (Latest Editions)**

1. Andreja, J. RF. (2011). Basic communication skills for Technology, 2nd Edition, New Delhi: Pearson Education.
2. Kumar, S. (2011). Communication skills, 1st Edition, New Delhi: Oxford Press.
3. Robbins, S. P. (2013). Organizational Behaviour, 1st Edition, New Delhi: Pearson.
4. Hasson, G. B. (2011). Communication skills, 1st Edition, New Delhi: Pearson Life.
5. Gopala, S.R. (2013). The Ace of Soft Skills: Attitude, Communication and Etiquette for success, 5thEdition, New Delhi: Pearson.
6. Deborah, D., Lois, B. M., Green, H. (2010). Developing your influencing skills, 1st Edition, Universe of Learning LTD.

**Reference Books:**

1. Mitra, B. K. (2011). Personality development and soft skills, 1st Edition, Oxford Press.
2. Butter, F. (2011). Soft skill for everyon. 1st Edition, Cengage Learning India pvt. Ltd.
3. Francis, PSJ. (2011). Soft skills and professional communication, 1st Edition, Mc Graw Hill Education.
4. Pan, MM. & John Adair (2009). Effective communication. 4th Edition. Cengage learning

## Teaching learning process and assessment

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will learn the importance of communication skills | Traditional chalk and black board method, Audio visual presentation. Class room discussion | Unit -test and practical assessment through presentations by the students |
| II. | Students will be taught about various perspectives in Communication | Traditional chalk and black board method and presentations and class discussions | Assignments, unit –test and practical assessment |
| III | Students will learn about elements of communication | Traditional method and presentations and class discussions | Assignments, unit –test and practical assessment |
| IV | Students will be able to learn about styles of communication skills | Through audio visual presentations | Assignments, unit –test and practical assessment |

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| **Paper VI/Subject Name: REMEDIAL BIOLOGY (Theory)** | | |
|---|---|---|
| **L-T-P-C – 2-0-1-3** | **Credit Units: 3** | **Scheme of Evaluation: (T/P/TP)** |

**Objective:** To learn and understand the components of living world, structure and functional system of plant and animal kingdom.

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

1. Know the classification and salient features of five kingdoms of life
2. Understand the basic components of anatomy & physiology of plant
3. Know understand the basic components of anatomy & physiology animal with special reference to human

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Living world:**<br>Definition and characters of living organisms<br>Diversity in the living world<br>Binomial nomenclature<br>Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus,<br><br>**Morphology of Flowering plants**<br>Morphology of different parts of flowering plants – Root, stem, inflorescence,flower, leaf, fruit, seed.<br>General Anatomy of Root, stem, leaf of monocotyledons &Dicotylidones. | **07 Hours** |
| **II.** | **Body fluids and circulation**<br>Composition of blood, blood groups, coagulation of blood<br>Composition and functions of lymph<br>Human circulatory system<br>Structure of human heart and blood vessels<br>Cardiac cycle, cardiac output and ECG<br>**Digestion and Absorption**<br>Human alimentary canal and digestive glands<br>Role of digestive enzymes<br>Digestion, absorption and assimilation of digested food<br>**Breathing and respiration**<br>Human respiratory system<br>Mechanism of breathing and its regulation<br>Exchange of gases, transport of gases and regulation of respiration<br>Respiratory volumes | **07 Hours** |
| **III.** | **Excretory products and their elimination**<br>Modes of excretion<br>Human excretory system- structure and function<br>Urine formation<br>Rennin angiotensin system<br>**Neural control and coordination**<br>Definition and classification of nervous system<br>Structure of a neuron<br>Generation and conduction of nerve impulse<br>Structure of brain and spinal cord<br>Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata<br>**Chemical coordination and regulation**<br>Endocrine glands and their secretions<br>Functions of hormones secreted by endocrine glands<br>**Human reproduction** | **07 Hours** |

| | | |
|---|---|---|
| | Parts of female reproductive system<br>Parts of male reproductive system<br>Spermatogenesis and Oogenesis<br>Menstrual cycle | |
| **IV** | **Plants and mineral nutrition:**<br>Essential mineral, macro and micronutrients<br>Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation<br>**Photosynthesis**<br>Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis<br>**Plant respiration:**Respiration, glycolysis, fermentation (anaerobic).<br>**Plant growth and development**Phases and rate of plant growth, Condition of growth,Introduction to plant growthregulators<br>**Cell - The unit of life**<br>Structure and functions of cell and cell organelles.Cell division<br>**Tissues**Definition, types of tissues, location and functions. | **09 Hours** |
| **TOTAL** | | **30 Hours** |

**REMEDIAL BIOLOGY (Practical)**
**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | 1. Introduction to experiments in biology<br>a) Study of Microscope<br>b) Section cutting techniques<br>c) Mounting and staining<br>d) Permanent slide preparation | **8 hr** |
| **II** | Study of cell and its inclusions<br>Study of Stem, Root, Leaf, seed, fruit, flower and their modifications | **8 hr** |
| **III.** | Detailed study of frog by using computer models<br>Microscopic study and identification of tissues pertinent to Stem, Root<br>Leaf, seed, fruit and flower<br>Identification of bones | **8 hr** |
| **IV.** | Determination of blood group<br>Determination of blood pressure<br>Determination of tidal volume | **6 hr** |
| **Total** | | **30 hr** |

**Text Book: (Latest Editions)**
a. Gokhale, S. B., Kalaskar, M.G. (2007). Text book of Remedial Biology , 3rd Edition, New Delhi: Nirali Prakashan.
b. Vyawahare, N., Singh, A., Shirode, A., Kulkarni, A. (2018), Text Book of Remedial Biology, 1st Edition, Nirali Prakashan .

**Reference Books**
a. Naidu, B.V. S. (2018). A Text book of Biology, 34th Edition, Nirali Prakashan.
c. Dutta, A.C. (1997). Botany for Degree students, 6th Edition, New Delhi, CBS Publishers.
d. Ayyer, M. E.(2011). Outlines of Zoology, 4th Edition, New Delhi, New Age publication.
e. Gokhale, S.B. & Kokate, C. K. (2007). A manual for pharmaceutical biology practical, 5th Edition, New Delhi: Nirali Prakashan.

**Teaching learning process and assessment**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will learn the concepts of life and living organism as well different morphology of flowers | Traditional chalk and black board method, Audio visual presentation. Class room discussion | Assignment, unit -test and discussions |
| II. | Students will learn about the body fluids and circulations, absorption and digestion etc | Traditional chalk and black board method with examples and presentations | assignments, class tests and practical demonstrations in the laboratory |
| III | Students will learn about excretory products and the process of its elimination, neuronal control and coordination between chemicals and their regulation etc. | Power point presemtations, audio visual demonstrations, traditional method | MCQs , quize , internal assessments etc. |
| IV | Students will learn about the plant and their regulatory functions | Power point presemtations, audio visual demonstrations, traditional chalk and board method | Assignments, discussions MCQ tests |

| Paper VII/Subject Name: REMEDIAL MATHEMATICS | | |
|---|---|---|
| **L-T-P-C – 3-0-0-3** | **Credit Units: 3** | **Scheme of Evaluation: (T/P/TP)** |

**Objective:** This is an introductory course in mathematics. This subject deals with the introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and Laplace transform.\

**Course Outcome**: Upon completion of the course the student shall be able to:-
**1.** Know the theory and their application in Pharmacy
**2.** Solve the different types of problems by applying theory
**3.** Appreciate the important application of mathematics in Pharmacy

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Partial fraction:**Introduction, Polynomial, Rational fractions, Proper and Improper fractions,Partial fraction , Resolving into Partial fraction, Application of PartialFraction in Chemical Kinetics and Pharmacokinetics<br>**Logarithms :**Introduction, Definition, Theorems/Properties of logarithms, Commonlogarithms, Characteristic and Mantissa, worked examples, application oflogarithm to solve pharmaceutical problems.<br>**Function***:*Real Valued function, Classification of real valued functions,<br>**Limits and continuity** :Introduction , Limit of a function, Definition of limit of a function of ((- definition)<br>$\lim_{x \to a} \frac{x^n - a^n}{x - a} = na^{n-1}$ , $\lim_{\theta \to 0} \frac{\sin\theta}{\theta} = 1.$ | **06Hours** |
| **II.** | **Matrices and Determinant:**Introduction matrices, Types of matrices, Operation on matrices,Transpose of a matrix, Matrix Multiplication, Determinants, Properties ofdeterminants , Product of determinants, Minors and co-Factors, Adjointor adjugate of a square matrix , Singular and non-singular matrices,Inverse of a matrix, Solution of system of linear of equations using matrixmethod, Cramer's rule, Characteristic equation and roots of a squarematrix, Cayley–Hamilton theorem,Applicationof Matrices in solvingPharmacokinetic equations | **06 Hours** |
| **III.** | **Calculus Differentiation** : Introductions, Derivative of a function, Derivative of aconstant, Derivative of a product of a constant and a function , Derivativeof the sum or difference of two functions, Derivative of the product of twofunctions (product formula), Derivative of the quotient of two functions(Quotient formula) – **Without Proof**, Derivative of *xnw.r.t*x,where*n* is anyrational number, Derivative of *ex*,, Derivative of loge *x* , Derivative of*ax*Derivative of trigonometric functions from first principles **(without Proof)**, Successive Differentiation, Conditions for a function to be amaximum or a minimum at a point. Application | **06 Hours** |

| | | |
|---|---|---|
| **IV.** | **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 **Integration:**Introduction, Definition, Standard formulae, Rules of integration , Method ofsubstitution, Method of Partial fractions, Integration by parts, definiteintegrals, application **Differential Equations** : Some basic definitions, Order and degree, Equations in separable form , Homogeneous equations, Linear Differential equations, Exact equations, **Application in solving Pharmacokinetic equations** **Laplace Transform** : Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, **Application in solving Chemical kinetics and Pharmacokinetics equations** | **11 Hours** |
| **TOTAL** | | **30 Hours** |

**Text book;**

1. Shanti, N., Mittal, P.K. (1942). Differential Calculus, 15th Edition, New Delhi: S.Chand.
2. Panchaksharappa, G.H. (2014). Pharmaceutical Mathematics with application to Pharmacy, 1st Edition, New Delhi: S. Chand.

**Reference Book:**

1. Shanti, N., Mittal, P.K. (2005). Integral Calculus, 35th Edition, New Delhi: S.Chand.
2. Grewal, B.S. (1965). Higher Engineering Mathematics, 4th Edition, Kolkata: CBS Publishers.

## Teaching learning process and assessment

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Introduction to Partial fraction, Limits and continuity, Function etc | Traditional chalk and black board method, Class room discussion | Assignment, unit -test and discussions |
| II. | Students will be taug.ht about Matrices and Determinant | Traditional chalk and black board , classroom discussions | assignments, written tests |
| III | Introduction to Calculus Differentiation. | Traditional teaching method | Internal assessments etc. |
| IV | Analytical Geometry Introduction | Traditional chalk and board method | Assignments, discussions class tests |

**Paper VI/Subject Name: ENVIRONMENTAL SCIENCES I (Theory)**

**L-T-P-C – 1-0-0-1** **Credit Units: 1** **Scheme of Evaluation: (T/P/TP)**

**Objective:** Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

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

1. Create the awareness about environmental problems among learners.
2. Impart basic knowledge about the environment and its allied problems.
3. Develop an attitude of concern for the environment.
4. Motivate learner to participate in environment protection and environment improvement.
5. Acquire skills to help the concerned individuals in identifying and solving environmental problems.

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | The Multidisciplinary nature of environmental studies Natural Resources<br>Renewable and non-renewable resources. | **4 hour** |
| **II.** | Natural resources and associated problems<br>a) Forest resources; b) Water resources; | **4 hour** |
| **III.** | Natural resources and associated problems<br>c) Mineral resources; d) Food resources ; | **4 hour** |
| **IV.** | Natural resources and associated problems<br>e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources. | **4 hour** |
| **TOTAL** | | **16 hour** |

**Recommended Books (Latest edition):**

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore, 1st Edition, 2006.
2. Agarwal, K.C. Environmental Biology, Nidi Publ. Ltd. Bikaner. 2nd Edition, 2001
3. Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India,1st Edition 2003.
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clanderson Press Oxford

6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T.

**Reference Books:**

1. Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p, 2001,2nd Edition
2. De A.K., Environmental Chemistry, Wiley Eastern Ltd.7th Edition, 2007
3. Down of Earth, Centre for Science and Environment

**Teaching learning process and assessment method.**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be aware about environmental problems. | Traditional chalk and board teaching, power point demonstration | Assignments, class tests. MCQs, quiz |
| II. | Students will learn about about the environment and its allied problems | Traditional chalk and board teaching, power point demonstration | Assignments, MCQ tests, internal assessments, quiz |
| III | Students will acquire skills to help the concerned individuals in identifying and solving environmental problems | Classroom discussions, power point demonstrations | Internal assessments, assignments, discussion |
| IV | Students will get to learn about how to develop an attitude of concern for the environment. | Power point presentations, regular discussions in the classroom and practical demonstration about the surrounding environment will help them to understand about the environment. | Knowledge gathering assignments , quiz on environment. |

# SYLLABUS II SEMESTER

**Paper I/Subject Name: HUMAN ANATOMY AND PHYSIOLOGY-II (Theory)**
**L-T-P-C – 3-1-2-6 Credit Units: 6 Scheme of Evaluation: (T/P/TP)**

**Objective:** This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

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

1. Explain the gross morphology, structure and functions of various organs of the human body.
2. Describe the various homeostatic mechanisms and their imbalances.
3. Identify the various tissues and organs of different systems of human body.
4. 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.
5. Appreciate coordinated working pattern of different organs of each system
6. Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Nervous system**<br>Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.<br>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) | **10 hours** |
| **II.** | **Digestive system**<br>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.<br>**Energetics**<br>Formation and role of ATP, Creatinine Phosphate and BMR. | **10 hours** |
| **III.** | **Respiratory system 10 hours**<br>Anatomy of respiratory system with special reference to anatomy of lungs,<br>mechanism of respiration, regulation of respiration<br>Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods.<br>**Urinary system**<br>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. | **10 hours** |
| **IV.** | **Endocrine system**<br>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.<br>**Reproductive system**<br>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<br>**Introduction to genetics**<br>Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance | **15 hours** |
| | **Total** | **45 hours** |

**HUMAN ANATOMY AND PHYSIOLOGY-II (Practical)**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | 1. To study the integumentary and special senses using specimen, models, etc.,<br>2. To study the nervous system using specimen, models, etc.,<br>3. To study the endocrine system using specimen, models, etc<br>4. To demonstrate the general neurological examination | **4 hr/wk** |
| **II.** | 5. To demonstrate the function of olfactory nerve<br>6. To examine the different types of taste.<br>7. To demonstrate the visual acuity<br>8. To demonstrate the reflex activity, | **4 hr/wk** |
| **III.** | 9. Recording of body temperature<br>10. To demonstrate positive and negative feedback mechanism.<br>11. Determination of tidal volume and vital capacity.<br>12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive<br>systems with the help of models, charts and specimens. | **4 hr/wk** |
| **IV** | 13. Recording of basal mass index .<br>14. Study of family planning devices and pregnancy diagnosis test.<br>15. Demonstration of total blood count by cell analyser<br>16. Permanent slides of vital organs and gonads. | **4 hr/wk** |
| **TOTAL** | | **60 hr** |

**Recommended Books:**

1. Sembulingam, K., Sembulingam, P. (2012). Essentials of Medical Physiology, 6th Edition, New Delhi: Jaypee brothers medical publishers.
2. Wilson, J.W., Livingstone, K. C. (1987). Anatomy and Physiology in Health and Illness, 6th Revised Edition, New York: Churchill Livingstone.
3. Tandon, O.P., Tripathi, R. (2011). Best and Tailor's Physiological basis of Medical Practice, 13th Edition, USA: Williams & Wilkins
4. Arthur, C. Guyton., Hall, E. J. (2011). Text book of Medical Physiology, 12th Edition, USA: Elseviers.
5. Grabowski, T., Palmetto, G. A. (2014). Principles of Anatomy and Physiology, 14th Edition, USA: Wiley inter-science.
6. Singh, I. (2011). Textbook of Human Histology, 6th Edition, New Delhi: Jaypee brother's medical publishers.
7. Ghai, C.L.(2013). Textbook of Practical Physiology, 8th Edition, New Delhi: Jaypee brother's medical publishers.

**Reference Books:**

1. Tandon, O.P., Tripathi, R. (2011). Best and Tailor's Physiological basis of Medical Practice. 13th Edition. USA: Williams & Wilkins
2. Arthur, C. Guyton., Hall, E. J. (2011). Text book of Medical Physiology. 12th Edition. USA: Elsevier's.
3. Chatterrje, C. C. (2017). Human Physiology. 11th Edition. Kolkata: Academic Publishers.

**Teaching learning process and assessment**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|

| | | | |
|---|---|---|---|
| I. | Students will learn about the gross morphology, structure and functions of various organs of the human body | Traditional chalk and black board method, Class room discussion, audio-visual presentations | Assignment, unit -test and discussions |
| II. | Students will be able to describe the various homeostatic mechanisms and their imbalances | Traditional chalk and black board , classroom discussions, presentations | assignments, written tests, MCQs, quizzes. |
| III | Introduction to the respiratory system, urinary system | Traditional teaching method, power point presentations, pictorial demonstrations, lab demonstrations | Internal assessments, assignments, internal assessments etc. |
| IV | Students will be able to learn about the reproductive system, endocrine system and genetics | Traditional chalk and board method, various vdo presentations will help the students to correlate with the theory part. | Assignments, discussions class tests |

**Paper II/Subject Name: PHARMACEUTICAL ORGANIC CHEMISTRY –I (Theory)**
**L-T-P-C – 3-1-2-6 Credit Units: 6 Scheme of Evaluation: (T/P/TP)**

**Objective:** This subject deals with classification and nomenclature of simple organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions and methods of preparation of these compounds. The syllabus also emphasizes on mechanisms and orientation of reactions.

**Course Outcome**: Upon completion of the course the student shall be able to
1. write the structure, name and the type of isomerism of the organic compound
2. write the reaction, name the reaction and orientation of reactions
3. account for reactivity/stability of compounds,
4. identify/confirm the identification of organic compound.

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Classification, nomenclature and isomerism**<br>Classification of Organic Compounds<br>Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds)<br>Structural isomerisms in organic compounds | **10 hours** |
| **II.** | **Alkanes*, Alkenes* and Conjugated dienes***<br>SP3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins.<br>Stabilities of alkenes, SP2 hybridization in alkenes<br>E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E1 verses E2 reactions, Factors affecting E1 and E2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation.<br>Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement | **10 hours** |
| **III.** | **Alkyl halides***<br>SN1 and SN2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations.<br>SN1 versus SN2 reactions, Factors affecting SN1 and SN2 reactions<br>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 | **10 hours** |
| **IV.** | **Carbonyl compounds* (Aldehydes and ketones)**<br>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, **Carboxylic acids***<br>Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids ,amide and ester<br>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 | **15 hours** |
| **Total** | | **45 hours** |

**PHARMACEUTICAL ORGANIC CHEMISTRY –I Practical**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | Systematic qualitative analysis of unknown organic compounds like<br>1. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc.<br>2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test<br>3. Solubility test<br>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. | **4 hr/wk** |
| **II.** | 5. Melting point/Boiling point of organic compounds<br>6. Identification of the unknown compound from the literature using melting point/ boiling point.<br>7. Preparation of the derivatives and confirmation of the unknown compound bymelting point/ boiling point. | **4 hr/wk** |
| **III.** | 8. Minimum 5 unknown organic compounds to be analysed systematically.<br>9. Preparation of suitable solid derivatives from organic compounds | **4 hr/wk** |
| **IV** | 10. Construction of molecular models | **4 hr/wk** |
| **TOTAL** | | **40 hr** |

**Recommended Books**

1. Morrison and Boyd. (2010). Organic Chemistry , 7th Edition, Pearson education.
2. Finar, I.L. (2002). Organic Chemistry, Volume-I, 6th Edition, Pearson education India.
3. Bahl, B.S & Bahl, A. (2016). Textbook of Organic Chemistry, 22nd Edition, S.Chand.
4. Soni, P.L. (2012). Organic Chemistry, 12th Edition, Pearson education India.
5. Mann and Saunders. (2009). Practical Organic Chemistry, 4th Edition, Pearson education India.
6. Furniss, B.S., Hannaford, S., Antony, J. (1989). Vogel's text book of Practical Organic Chemistry. 5th Edition, Pearson education India.

**Reference Book:**

1. Vishnoi, N. K. (2009). Advanced Practical organic chemistry. 4th Edition. New Delhi: Mann & Saunders.
2. Pavia, Donald L. & Kriz, G.M. (2010). Introduction to Organic Laboratory techniques. 3rd Edition; New Delhi: Brooks/Cole publishers.
3. Ahluwaliah, V.K. & Parashar, R.K. (2010). Reaction and reaction mechanism. 4th Edition; New Delhi: Narosa Publishing House.

**Teaching learning process and assessment**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to learn and write the structure, name and the type of isomerism of the organic compound | Traditional chalk and black board method, Class room discussion, laboratory tests | Assignment, unit -test and discussions, MCQ tests |
| II. | Students will learn various reaction, name the reaction and orientation of reactions | Traditional chalk and black board , pictorial demonstratios, classroom discussions, testing in lab | Assignments, MCQ tests, internal assesments |
| III | Understand reactivity/stability of compounds, | Traditional teaching method, PPT | Internal assessments, MCQ assignment |
| IV | Identify/confirm the identification of organic compound. | Traditional chalk and board method, power point presentations. | Assignments, discussions class tests etc. |

**Paper III/Subject Name: BIOCHEMISTRY (Theory)** **L-T-P-C – 3-1-2-6**
**Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective**: The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.

**Course Outcome**: Upon completion of course student shell able to

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

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

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

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| I. | **Biomolecules**<br>Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.<br>**Bioenergetics**<br>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 | **8 hour** |
| II. | **Carbohydrate metabolism**<br>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<br>**Biological oxidation**<br>Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation & its mechanism and substrate level phosphorylation Inhibitors ETC and oxidative phosphorylation/Uncouplers | **10 hour** |
| III. | **Lipid metabolism**<br>β-Oxidation of saturated fatty acid (Palmitic acid) Formation and utilization of ketone bodies; ketoacidosis De novo synthesis of fatty acids (Palmitic acid), Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D, Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.<br>**Amino acid metabolism**<br>General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia) Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline<br>Catabolism of heme; hyperbilirubinemia and jaundice | **10 hour** |
| IV | **Nucleic acid metabolism and genetic information transfer**<br>Biosynthesis of purine and pyrimidine nucleotides<br>Catabolism of purine nucleotides and Hyperuricemia and Gout disease<br>Organization of mammalian genome<br>Structure of DNA and RNA and their functions<br>DNA replication (semi conservative model) | **17 hour** |

| | | |
|---|---|---|
| | Transcription or RNA synthesis<br>Genetic code, Translation or Protein synthesis and inhibitors<br>**Enzymes**<br>Introduction, properties, nomenclature and IUB classification of enzymes<br>Enzyme kinetics (Michaelis plot, Line Weaver Burke plot) Enzyme inhibitors with examples<br>Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation<br>Therapeutic and diagnostic applications of enzymes and isoenzymes<br>Coenzymes –Structure and biochemical functions | |
| **TOTAL** | | **45 hour** |

## PHARMACEUTICAL BIOCHEMISTRY (Practical)

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | 1. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose,<br>Sucrose and starch)<br>2. Identification tests for Proteins (albumin and Casein)<br>3. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method) | **4 hr/wk** |
| **II.** | 4. Qualitative analysis of urine for abnormal constituents<br>5. Determination of blood creatinine<br>6. Determination of blood sugar | **4 hr/wk** |
| **III.** | 7. Determination of serum total cholesterol<br>8. Preparation of buffer solution and measurement of pH<br>9. Study of enzymatic hydrolysis of starch | **4 hr/wk** |
| **IV** | 10. Determination of Salivary amylase activity<br>11. Study the effect of Temperature on Salivary amylase activity.<br>12. Study the effect of substrate concentration on salivary amylase activity. | **4 hr/wk** |
| **TOTAL** | | **48 hr** |

**Recommended Books (Latest Editions)**

1. Nelson, D.L., Cox, M.M. (2017). Lehninger Principles of Biochemistry, 7th Edition; WH Freeman publishers.
2. Robert, K., Murry, Daryl., Granner, K., Victor, W.R. (2015). Harper's Biochemistry, 30th Edition, New Delhi: McGraw-Hill Education / Medical publishers.
3. Jeremy, M. B., Stryer, L., Tymoczko, J., Gatto, G. (2019). Biochemistry, 9th Edition, New Delhi:WH Freeman publishers.
4. Satyanarayan, U., Chakrapani, U. (2017). Biochemistry, 5th Edition; Elsevier India.
5. Rama, Rao. (2017). Textbook of Biochemistry, 10th Edition; UBS Publishers\' Distributors Pvt. Ltd.
6. Deb, A. C. (2001), Fundamentals of Biochemistry, 9th Edition; New Central Book Agency (p) Ltd
7. Conn, E.E., Stumpf, K.P., George B. (2006). Outlines of Biochemistry, 5th Edition; Wiley publishers.
8. Gupta, R.C and Bhargava, S. Practical Biochemistry, 5th Edition; New Delhi: CBS publishers and distributors.
9. Plummer, David T. (2010). Introduction of Practical Biochemistry, 3rd Edition; Tata McGraw-Hill Education Pvt. Ltd.

**Reference Book:**

1. Rajagopal, G. & Tura, B.D. (2005). Practical Biochemistry for Medical students. 2nd Edition. Ahuja Publishing House.
2. Harold, Varley. (2005). Practical Biochemistry. 4th Edition. CBS publishers and distributors.

**Teaching learning process and assessment**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes | Traditional chalk and black board method, Class room discussion, | Assignment, unit -test and discussions, MCQ tests |
| II. | Understand the metabolism of nutrient molecules in physiological and pathological conditions. | Traditional chalk and black board , classroom discussions, testing in lab | Assignments, MCQ tests, internal assessments, quiz |
| III | Students will learn about lipid and amino acid metabolism | Traditional teaching method, Power point presentations, | Internal assessments , assignments, lab experiments. |
| IV | Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and enzymes | Traditional chalk and board method and power point presentations. | Assignments, discussions class tests etc. |

**Paper IV/Subject Name: PATHOPHYSIOLOGY (THEORY)**
**L-T-P-C – 3-1-0-4 Credit Units: 4 Scheme of Evaluation: (T/P/TP)**

**Objective:** Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes. This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge required to practice medicine safely, confidently, rationally and effectively.

**Course Outcome**: Upon completion of the subject student shall be able to –
1. Describe the etiology and pathogenesis of the selected disease states;
2. Name the signs and symptoms of the diseases; and
3. Mention the complications of the diseases.
4. Describe the sign and symptoms of Infectious diseases and cancer

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **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 | **10 hour** |
| **II.** | **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 . | **10 hour** |
| **III.** | **Haematological Diseases:** Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia **Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones **Nervous system:** Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease. **Gastrointestinal system:** Peptic Ulcer | **10 hour** |
| **IV** | 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 **Infectious diseases:** Meningitis, Typhoid, Leprosy, Tuberculosis Urinary tract infections **Sexually transmitted diseases:** AIDS, Syphilis, Gonorrhea | **15 hour** |
| **TOTAL** | | **45 hour** |

**Recommended Books (Latest Editions)**

1. Kumar, V., Abas, A.K., Aster, J.C. (2014). Robbins &Cotran Pathologic Basis of Disease-South Asia edition; 9th Edition: India; Elsevier.
2. Harsh, M. (2010). Text book of Pathology, 6th Edition; Jaypee Publications.
3. Laurence, B., Bruce, C., Bjorn, K. (2011). Goodman & Gilman's The Pharmacological Basis of Therapeutics, 12th Edition; New York:McGraw-Hill.
4. Best, C. H., Taylor, N. B., West, J. B. (1991). Best and Taylor's Physiological basis of medical practice, 12th Edition; USA: William and Wilkins.
6. Nicki, R., Colledge, B. R., Walker, S. H. (2010). Davidson's Principles and Practice of Medicine, 21st Edition; London: ELBS/Churchill Livingstone.

**Reference Books:**

1. Guyton, A., Hall, J.E. (2010). Textbook of Medical Physiology, 12th Edition;WB Saunders Company.
2. DiPiro, J., Robert, L.R., Gary, Y., Barbara, Wells.,, L. Posey, L.M. (2014). Pharmacotherapy: A Pathophysiological Approach, 9th Edition; London: McGraw-Hill Medical.
3. Kumar, V., Cotran, R.S., Robbins, S.L. (1997). Basic Pathology, 6th Edition; Philadelphia: WB Saunders Company.
4. Walker, R., Edwards, C. (2003). Clinical Pharmacy and Therapeutics, 3rd Edition; London: Churchill Livingstone publication

**Teaching learning process and assessment**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to describe the etiology and pathogenesis of the selected disease states; | Traditional chalk and black board method, Class room discussion, | Assignments, MCQ tests, class tests. |
| II. | Students will learn about signs and symptoms of the diseases like Cardiovascular System, Respiratory system, Renal system and Mention the complications of the diseases | Traditional chalk and black board , classroom discussions, testing in lab | Assignments, MCQ tests, internal assessments, quiz |
| III | Students will be able to learn about signs and symptoms of the diseases blood and related disorders, GIT disorders, endocrine system and Mention the complications of the diseases | Traditional teaching method, Power point presentations, pictorial demonstration. | Internal assessments, assignments, discussion |
| IV | Introduction to disease of bones and joints, infectious diseases, sexually transmitted disease etc and and Mention the complications of the diseases | Traditional chalk and board method and power point presentations. | Assignments, discussions class tests etc. |

**Paper V/Subject Name: COMPUTER APPLICATIONS IN PHARMACY (Theory)**
**L-T-P-C – 3-0-1-4 Credit Units: 4 Scheme of Evaluation: (T/P/TP)**

**Objective**: This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.

**Course Outcome**: Upon completion of the course the student shall be able to
1. Know the various types of application of computers in pharmacy
2. Know the various types of databases
3. Know the various applications of databases in pharmacy
4. Know the application of computer in preclinical development

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **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<br>**Concept of Information Systems and Software : I**nformation gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project | **06 hour** |
| **II.** | **Web technologies**:Introduction to HTML, XML,CSS and Programming languages, introduction to web servers and Server<br>Products; Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database | **6 hour** |
| **III.** | **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<br>Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System | **6 hour** |
| **IV** | **Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine<br>Discovery<br>**Computers as data analysis in Preclinical development**:<br>Chromatographic dada analysis(CDS), Laboratory Information management<br>System (LIMS) and Text Information Management System(TIMS) | **12 hour** |
| **TOTAL** | | **30 hour** |

**COMPUTER APPLICATIONS IN PHARMACY (Practical)**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | 1. Design a questionnaire using a word processing package to gather information<br>about a particular disease.<br>2. Create a HTML web page to show personal information.<br>3 Retrieve the information of a drug and its adverse effects using online | **2 hr/wk** |

| | | |
|---|---|---|
| | tools | |
| **II.** | 4 Creating mailing labels Using Label Wizard , generating label in MS WORD<br>5 Create a database in MS Access to store the patient information with the required fields Using access<br>6. Design a form in MS Access to view, add, delete and modify the patient record in the database | **2 hr/wk** |
| **III.** | 7. Generating report and printing the report from patient database<br>8. Creating invoice table using – MS Access<br>9. Drug information storage and retrieval using MS Access | **2 hr/wk** |
| **IV** | 10. Creating and working with queries in MS Access<br>11. Exporting Tables, Queries, Forms and Reports to web pages<br>12. Exporting Tables, Queries, Forms and Reports to XML pages | **2hr/wk** |
| **TOTAL** | | **24 hr** |

**Recommended books:**

1. Fassett, W.E. (1986). Computer Application in Pharmacy, 1st Edition; USA: Lea and Febiger publishers.
2. Sea, Akins. (2006). Computer Application in Pharmaceutical Research and Development, 1st Edition; USA: Wiley-Interscience.
3. Rastogi, S.C. (2013). Bioinformatics (Concept, Skills and Applications), 2nd Edition; New Delhi: CBS Publishers and Distributors.

**Reference Book:**

1. Cary, N. Prague. (2003). Microsoft office Access-Application Development Using VBA, SQL Server, DAP and Infopath, 3rd Edition; New Delhi: Wiley Dreamtech India (P) Ltd.

**Teaching learning process and assessment method**

| **Unit No.** | **Course Learning Outcomes** | **Teaching and Learning Activity** | **Assessment Tasks** |
|---|---|---|---|
| I. | Students will be able to learn various types of application of computers in pharmacy | Through computers and classroom discussions | Assignments, class tests. MCQs, practicing in lab |
| II. | Will be able to learn various web technologies | Through computers and classroom discussions | Assignments, MCQ tests, internal assessments, quiz |
| III | Students will be able to learn about the various applications of computers in pharmacy | Through computers and classroom discussions | Internal assessments, assignments, discussion |
| IV | Students will be taught about the uses of softwares in Preclinical development. | Power point presentations, internet access, and practical demonstrations of various softwares will help the students to learn about its applications. | Practicing the uses of softwares in computer lab |

**Paper VI/Subject Name: ENVIRONMENTAL SCIENCES II (Theory)**

**L-T-P-C – 2-0-0-2** **Credit Units: 2** **Scheme of Evaluation: (T/P/TP)**

**Objective:** Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

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

1. Create the awareness about environmental problems among learners.
2. Impart basic knowledge about the environment and its allied problems.
3. Develop an attitude of concern for the environment.
4. Motivate learner to participate in environment protection and environment improvement.
5. Acquire skills to help the concerned individuals in identifying and solving environmental problems.
6. Strive to attain harmony with Nature.

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | Ecosystems<br>Concept of an ecosystem.<br>Structure and function of an ecosystem.<br>Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) | **10 hour** |
| **II.** | Environmental Pollution: Air pollution | **4 hour** |
| **III.** | Water pollution; | **3 hour** |
| **IV.** | Soil pollution | **3 hour** |
| **TOTAL** | | **20 hour** |

**Recommended Books (Latest edition):**

1. Sing, K.Y. (2006). Environmental Science, 1st Edition; Bangalore: New Age International Pvt. Ltd.
2. Agarwal, K.C. (2001). Environmental Biology, 2nd Edition; Bikaner: Nidi Publication Ltd.
3. Bharucha, E. (2003). The Biodiversity of India, 1st Edition; Ahmedabad: Mapin Publishing Pvt. Ltd.
4. Brunner, R.C. (1989). Hazardous Waste Incineration, 1st Edition; USA: McGraw Hill Inc.
5. Clark R.B. (2001). Marine Pollution, 5th Edition; USA: Oxford University Press.

**Reference Books:**

1. Cunningham, W. P. (1996). Environmental Encyclopedia. 2nd Edition. Mumbai: Cengage Gale publishers.
2. De, A.K. (2007). Environmental Chemistry. 7th Edition. USA: Wiley Eastern Ltd.

**Teaching learning process and assessment method.**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be aware about environmental problems. | Traditional chalk and board teaching, power point demonstration | Assignments, class tests. MCQs, quiz |
| II. | Students will learn about about the environment and its allied problems | Traditional chalk and board teaching, power point demonstration | Assignments, MCQ tests, internal assessments, quiz |
| III | Students will acquire skills to help the concerned individuals in identifying and solving environmental problems | Classroom discussions, power point demonstrations | Internal assessments, assignments, discussion |
| IV | Students will get to learn about how pollution is increasing day by day on water and soil level and how it is affecting life. | Power point presentations, regular discussions in the classroom and practical demonstration about the surrounding environment will help them to understand about the environment. | Knowledge gathering assignments , quiz on environment. |

| Paper V/Subject Name: COMMUNICATION SKILLS II (Theory) | | |
|---|---|---|
| **L-T-P-C – 1-0-0-1** | **Credit Units: 1** | **Scheme of Evaluation: (T/P/TP)** |

**Obective:** This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.

**Course Outcome**: Upon completion of the course the student shall be able to
1. Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation
2. Communicate effectively (Verbal and Non Verbal)
3. Effectively manage the team as a team player
4. Develop interview skills
5. Develop Leadership qualities and essentials

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations<br>**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 | **06 Hours** |
| **II.** | **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message<br>**Interview Skills:** Purpose of an interview, Do's and Dont's of an interview | **05 Hours** |
| **III.** | **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery | **03 Hours** |
| **IV** | **Group Discussion:** Introduction, Communication skills in group discussion, Do's and Dont's of group discussion | **02 Hours** |
| **TOTAL** | | **16 Hours** |

**Text Book: (Latest Editions)**
1.Andreja. J. Ruther Ford; Basic communication skills for Technology, 2nd Edition, Pearson Education, 2011
2.Kumar S.; Communication skills,Pushpalata, 1stEdition, Oxford Press, 2011
3. Robbins S.P.;OrganizationalBehaviour, 1stEdition, Pearson, 2013
4. Hasson G.; Brilliant- Communication skills, 1stEdition, Pearson Life, 2011
5. Gopala Swamy Ramesh,The Ace of Soft Skills: Attitude, Communication and Etiquette for success, 5thEdition, Pearson, 2013
6. Deborah Dalley, Lois Burton, Margaret, Green hall, Developing your influencing skills, 1st Edition Universe of Learning LTD, 2010

**Reference Books:**
1. Mitra B K, Personality development and soft skills,1stEdition, Oxford Press, 2011
2. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning Indiapvt.ltd, 2011
3. Francis Peters SJ,Soft skills and professional communication, 1stEdition, Mc Graw Hill Education, 2011
4. Pan Mac Millan , Effective communication, John Adair, 4thEdition, ,2009
5. Mc Graw Hill, Bringing out the best in people, Aubrey Daniels, 2ndEdition, 1999

**Teaching learning process and assessment**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will learn the importance of communication skills | Traditional chalk and black board method, Audio visual presentation. Class room discussion | Unit -test and practical assessment through presentations by the students |
| II. | Students will be taught about various perspectives in Communication | Traditional chalk and black board method and presentations and class discussions | Assignments, unit –test and practical assessment |
| III | Students will learn about elements of communication | Traditional method and presentations and class discussions | Assignments, unit –test and practical assessment |
| IV | Students will be able to learn about styles of communication skills | Through audio visual presentations | Assignments, unit –test and practical assessment |

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# SYLLABUS III SEMESTER

**Paper I/Subject Name: PHARMACEUTICAL ORGANIC CHEMISTRY –II (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Course Objective:**

This subject deals with general methods of preparation and reactions of some Organic compounds. Reactivity of organic compounds are also studied here. The syllabus Emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.

**Course Outcomes:**

On completion of this course students will be expected to:
1. Write the structure, name and the type of isomerism of the organic compound
2. Write the reaction, name the reaction and orientation of reactions
3. Account for reactivity/stability of compounds,
4. Prepare organic compounds

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Benzene and its derivatives**<br>**A.** Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule<br>**B.**Reactions of benzene - nitration, sulphonation, halogenationreactivity, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation.<br>**C.** Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction<br>**D.** Structure and uses of DDT, Saccharin, BHC and Chloramine | **10 hours** |
| **II.** | **Phenols*** - Acidity of phenols, effect of substituents on acidity, qualitativetests, Structure and uses of phenol, cresols, resorcinol, naphthols<br>**Aromatic Amines* -** Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts<br>**Aromatic Acids* –**Acidity, effect of substituents on acidity and important reactions of benzoic acid.. | **10 hours** |
| **III.** | **Fats and Oils**<br>a. Fatty acids – reactions.<br>b. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.<br>c. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination. | **10 hours** |

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| **IV** | **Polynuclear hydrocarbons:**<br>a. Synthesis, reactions<br>b. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives<br>**Cyclo alkanes***<br>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 | **15hours** |

**Paper I/Subject Name: PHARMACEUTICAL ORGANIC CHEMISTRY –II (practical)**
**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| I | **Experiments involving laboratory techniques**<br>Recrystallization<br>Steam distillation | **4 Hrs/week** |
| II | Determination of following oil values (including standardization of reagents) Acid value, Saponification value, Iodine value | **4 Hrs/week** |
| III | **Preparation of compounds**<br>Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol /Aniline by acylation reaction.<br>2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/ Acetanilide by halogenation (Bromination) reaction.<br>5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction.<br>Benzoic acid from Benzyl chloride by oxidation reaction. | **4 Hrs/week** |
| IV | **Preparation of compounds**<br>Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.<br>1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions.<br>Benzil from Benzoin by oxidation reaction.<br>Dibenzal acetone from Benzaldehyde by Claison Schmidt reaction<br>Cinnammic acid from Benzaldehyde by Perkin react | **4 Hrs/week** |

**Text Book:**
**Recommended Books**

1. Morrison and Boyd (2010), Organic Chemistry, 7th edition Pearson education, India.
2. I.L. Finar. (2002). Organic Chemistry. Vol-I, 6th edition , Pearson education, India.
3. Bahl B.S. & Bahl Arun (2019)., Textbook of Organic Chemistry, 22nd edition. S.Chand publisher Ltd.
4. Pavia, Lampman and Kriz, Introduction to Organic Laboratory techniques 4th edn, 2006, saunders ltd.
5. Soni P.L., Organic Chemistry. 16th edition. S.Chand and sons publication.

**Reference Book:**

1. Mann F.G. and Saunders.(2011). Practical Organic Chemistry, 4th edition.Pearson education Ltd.
2. Vogel A.I.(1996). Vogel's text book of Practical Organic Chemistry. 5th edition. Pearson education Ltd.
3. NK Vishnoi and KS Tiwari.(2009). Advanced Practical organic chemistry, 4th edn, Vikas Publishing

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | Students will learn the structure, name and the type of different organic compounds | Traditional chalk and board method of teaching and regular class room discussion. Videos to showcase the 3D structure of different organic compounds. | Problem solving assignments, regular question answer sessions, MCQs and unit-test for internal assessment |
| **II** | Students will be able to write the reaction, name the reaction and orientation of reactions | Teaching will be conducted both through black board mode and power point presentation mode. | Oral questions will be asked in the class. Problems will be assigned to test student's analytical ability. |
| **III** | Understand account for reactivity/stability of compounds, | Teaching will be conducted both through black board mode and power point presentation mode. Discussions and quizzes will be conducted to keep the students up-to-date with the information they have received | MCQ based assignments will be given to students to check their understanding of the subject. |
| **IV** | Students will learn about preparation of different organic compounds | Appropriate mix of chalk and board teaching as well as use of Power point presentations for clarity of concepts with reactions, Practical demonstration will be given. | Internal assessment tests will be conducted, – presentations will be assessed along with practical assessment. |

**Paper II/Subject Name: PHYSICAL PHARMACEUTICS-I (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Course Objective:**

The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

**Course outcome:**

Upon the completion of the course student shall be able to

1. Understand various physicochemical properties of drug molecules in the designing the dosage forms
2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.
4. Understand acid and base based on pH scale and application of buffer.

**Detailed Syllabus:**

| Modules | Topics (if applicable) & Course Contents | Period |
|---|---|---|
| I | **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. Partiallymiscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications | 10 Hours |
| II | **i.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, solidcrystalline, amorphous & polymorphism.<br><br>**ii.Physicochemical properties of drug molecules:** Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications | 10 Hours |
| III | **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.<br><br>**Complexation and protein binding:** Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, | 15 Hours |

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|---|---|---|
| | Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants. | |
| IV | **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. | 8 Hours |

**PHYSICAL PHARMACEUTICS – I (Practical)**

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I** | 1. Determination the solubility of drug at room temperature<br>2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.<br>3. Determination of Partition co- efficient of benzoic acid in benzene and water | **4 Hrs/week** |
| **II** | 4. Determination of Partition co- efficient of Iodine in CCl4 and water<br>5. Determination of % composition of NaCl in a solution using phenol-water system by CST method<br>6. Determination of surface tension of given liquids by drop count and drop weight method | **4 Hrs/week** |
| **III** | 7. Determination of HLB number of a surfactant by saponification method<br>8. Determination of Freundlich and Langmuir constants using activated char coal<br>9. Determination of critical micellar concentration of surfactants | **4 Hrs/week** |
| **IV** | 10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method<br>11. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method | **4 Hrs/week** |

**Recommended Books: (Latest Editions)**

1. Singh, Y., Martin, A. N., Sinko, P. J. (2011). Martin's Physical Pharmacy and Pharmaceutical Sciences: 6th edition.United Kingdom: Lippincott Williams & Wilkins.
2. Eugene L Parrot, Witold Saski.(1977). Experimental Pharmaceutics,4th edition, Burgess Publication Ltd.
3. Carter S.J. (2008 ). Cooper and Gunn tutorial Pharmacy . 12th edition, CBS publication & distribution pvt. Ltd.
4. Stocklosam J.( (1991). Pharmaceutical Calculations 7th edition .Philadelphia, Lea &Febiger, Philadelphia.
5. Liberman H.A, Lachman C.(2013). Pharmaceutical Dosage forms. 13th edn, Vol 1, CBS Publisher and distributors.
6. Liberman H.A, Lachman C.(2009) Pharmaceutical Dosage forms. Disperse systems. 10th edition, volume 1, 2, 3. Marcel Dekkar Inc.

**Reference Book:**

1. Ramasamy C, Manavalan R.(2017). Physical Pharmaceutics. 2nd edition. PharmaMedPress.
2. Subramanyam C.V.S., Thimma settee J.(2014). Laboratory Manual of Physical Pharmaceutics. 2nd edition, Vallabh Prakashan.
3. Gaurav Jain, Roop K. Khar, Farhan J Ahmed, Theory and practice of physical pharmacy, 1st edn, 2011, Elsevier publisher.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | Students will learn about various physicochemical properties of drug molecules in the designing the dosage forms | Traditional chalk and board method of teaching and regular class room discussion with PPT and Video class. | Problem solving assignments, regular question answer sessions, MCQs and unit-test for internal assessment |
| **II** | Understand the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations | Teaching will be conducted both through black board mode and power point presentation mode. | Students will be given questions that are application based and require analytical skills. Quizzes will be held to gauge their conceptual understanding. |
| **III** | Understand account for reactivity/stability of compounds, | Teaching will be conducted both through black board mode and power point presentation mode. | MCQ based assignments will be given to students to check their understanding of the subject. |
| **IV** | Students will learn about acid and base based on pH scale and application of buffer. | Appropriate mix of chalk and board teaching as well as use of Power point presentations for clarity of concepts with reactions, Practical demonstration will be given. | Post lecture students will be given home assignments to enhance their learning and for assimilation of concepts. Prelecture quiz to evaluate students understanding of previous lecture. |

**Paper IV/Subject Name : PHARMACEUTICAL MICROBIOLOGY (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units:6** **Scheme of Evaluation: (T/P/TP)**

**Course Objective:** Study of all categories of microorganisms especially for the production of alcohol antibiotics, vaccines, vitamins enzymes etc.

**Course outcome:** Upon completion of the subject student shall be able to;
1. Understand methods of identification, cultivation and preservation of various microorganisms
2. To understand the importance and implementation of sterilization in pharmaceutical processing and industry
3. Learn sterility testing of pharmaceutical products.
4. Carried out microbiological standardization of Pharmaceuticals.
5. Understand the cell culture technology and its applications in pharmaceutical industries.

**Detailed Syllabus**

| **Modules** | **Topics (if applicable) & Course Contents** | **Periods** |
|---|---|---|
| I | 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. | 10 Hours |
| II | Identification of bacteria using staining techniques (simple, Gram's &Acid fast staining) and biochemical tests (IMViC).<br><br>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.<br><br>Sterility indicators. | 10 Hours |
| III | 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.<br><br>Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP. | 10 Hours |
| IV | Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification. Principles and methods of different | 15 Hours |

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|---|---|---|
| | microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic<br><br>Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.<br><br>Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures.<br><br>Application of cell cultures in pharmaceutical industry and research. | |

**PHARMACEUTICAL MICROBIOLOGY (practical)**

**Detailed Syllabus**

| **Modules** | **Topics (if applicable) & Course Contents** | **Periods** |
|---|---|---|
| **I** | 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.<br><br>2. Sterilization of glassware, preparation and sterilization of media.<br><br>3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations | **4 Hrs/week** |
| **II** | 4. Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical).<br><br>5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.<br><br>6. Microbiological assay of antibiotics by cup plate method and other methods | **4 Hrs/week** |
| **III** | 7. Motility determination by Hanging drop method.<br><br>8. Sterility testing of pharmaceuticals. | **4 Hrs/week** |
| **IV** | 9. Bacteriological analysis of water<br><br>10. Biochemical test. | **4 Hrs/week** |

**Recommended Books**

1. Hugo W.B and Russel A.D.(2004). Pharmaceutical Microbiology. 7th edn. Oxford London: Blackwell Scientific publications,.
2. Prescott and Dunn.(2011). Industrial Microbiology. 8th edition. Delhi:CBS Publishers &
3. Pelczar, Chan Kreig.(2001). Microbiology. 5th edition, Tata McGraw Hill publisher ltd.
4. Malcolm H.(1964). Pharmaceutical Microbiology, 5th edition. Balliere Tindall and Cox publisher.
5. Rose Anthony H.(1961). Industrial Microbiology, 4th edition. Bulter worths publisher
6. Martin Frobisher Hinsdill et al(1987). Fundamentals of Microbiology. 9th edition.Saunders, Philadelphia
7. Carter SJ.(2016). Cooper and Gunn's Tutorial Pharmacy, 12th edition. CBS publisher and distributors.
8. Peppler J H.(1979). Microbial Technology, 2nd edition, Academic press.
9. I.P., B.P., U.S.P.- latest editions (IP 8th edn, 2008; B.P. 2020, Vol 1 to 6; USP-43-NF38, Vol I-III)

**Reference Book:**

1. Ananthnarayan and Panikar's Text Book of Microbiology, 10th edn, 2017, Orient-Longman, Chennai
2. Edward Alcamo, Fundamentals of Microbiology, 4th edn, 2004,Benjamin-cummings Pub. Co. Ltd.
3. N.K.Jain: Pharmaceutical Microbiology, 2nd edn, 2008, Vallabh Prakashan, Delhi
4. Bergeys manual of systematic bacteriology, 2nd edn, 2012, Vol-I to V, Williams and Wilkins- A Waverly company.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | Understand methods of identification, cultivation and preservation of various microorganisms | Classical chalk and board teaching, oral discussions and power point presentation whenever needed. | Problem solving assignments, regular question answer sessions, MCQs and unit-test for internal assessment |
| **II** | Understand the importance and implementation of sterilization in pharmaceutical processing and industry | Teaching will be conducted both through black board mode and power point presentation mode. | Oral questions will be asked in the class. Students will be given to prepare power point presentation on the assigned topics related to the class teachings. |
| **III** | Students will learn sterility testing of pharmaceutical products. | Teaching will be conducted both through black board mode and power point presentation mode. | MCQ based assignments will be given to students to check their understanding of the subject. |
| **IV** | Understand the cell culture technology and its applications in pharmaceutical industries. | Both black board mode and power point presentation mode will be used. | Internal assessment tests; Students will be given questions that are application based. |

**Paper V/Subject Name : PHARMACEUTICAL ENGINEERING (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Course Objective:** This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

**Course outcome:** Upon completion of the course student shall be able:
1. To know various unit operations used in Pharmaceutical industries.
2. To understand the material handling techniques.
3. To perform various processes involved in pharmaceutical manufacturing process.
4. To carry out various test to prevent environmental pollution.
5. To appreciate and comprehend significance of plant lay out design for optimum use of resources.
6. To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I** | **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.<br><br>**Size Reduction:** Objectives, Mechanisms & Laws governing size reduction,<br><br>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.<br><br>**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. | **10 Hour** |
| **II** | **Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.<br><br>**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.<br><br>**Distillation:** Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation | **10 Hours** |
| **III** | **Drying:** Objectives, applications & mechanism of drying process, measurements | **08** |

| | | |
|---|---|---|
| | & 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.<br><br>**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, | **Hours** |
| **IV** | **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.<br><br>**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.<br><br>**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. | **15 hours** |

**PHARMACEUTICAL ENGINEERING (Practical)**

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I** | i.Determination of radiation constant of brass, iron, unpainted and painted glass.<br>ii. Steam distillation – To calculate the efficiency of steam distillation.<br>iii. To determine the overall heat transfer coefficient by heat exchanger. | **4 Hours/week** |
| **II** | IV. Construction of drying curves (for calcium carbonate and starch).<br>V. Determination of moisture content and loss on drying.<br>VI. Determination of humidity of air –<br>i) From wet and dry bulb temperatures –use of Dew point method. | **4 Hours/week** |
| **III** | VII. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.<br>VIII. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots.<br>IX. 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. | **4 Hours/week** |
| **IV** | X. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.<br>XI. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity<br>XII. To study the effect of time on the Rate of Crystallization. | **4 Hours/week** |

| | | |
|---|---|---|
| | XIII. To calculate the uniformity Index for given sample by using Double Cone Blender. | |

**Recommended Books:**

1. Badger W.L. & Banchero J. (1955). Introduction to chemical engineering, US. McGraw-Hill Inc.,
**2**. Nigel J.K. Simpson. (2000). Solid phase extraction, Principles, techniques and applications**.** New York and Basel**:** marcel Dekker Inc.
3. Mcabe W.L., Smith J.C. Unit operation of chemical engineering, 5th edition.
4. Subrahmanyam C.V.S et al. Pharmaceutical engineering principles and practices. Vallabh Prakashan. ( Latest edition).
5. Remington practice of pharmacy- Martin, 21st edition. Lippincot.willium and wills.

**Reference Book:**

6. Khar K.R.etal.(2020) Theory and practice of industrial pharmacy by Lachman/ Lieberman, 4th edition. CBS publishers and distributors.
7. Subrahmanyam C.V.S et al (2000). A textbook Physical pharmaceutics, 2nd edition. Vallabh Prakashan.
8. Carter S.J. (1986) .Cooper and Gunn's Tutorial pharmacy, CBS publishers and distributors

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | Understand various unit operations used in Pharmaceutical industries | Teaching will be conducted both through black board mode and power point presentation mode. | MCQ based assignments will be given to students to check their understanding of the subject. |
| **II** | Understand the material handling techniques and perform various processes involved in pharmaceutical manufacturing process. | Teaching will be conducted both through black board mode and power point presentation mode. | Oral questions will be asked in the class. Students will be given to prepare power point presentation on the assigned topics related to the class teachings. |
| **III** | Students will learn various tests to prevent environmental pollution. | Teaching will be conducted both through black board mode and power point presentation mode. | Problem solving assignments, regular question answer sessions, MCQs and unit-test for internal assessment |
| **IV** | Appreciate and comprehend significance of plant lay out design for optimum use of resources and the various preventive methods used for corrosion control in Pharmaceutical industries | Both black board mode and power point presentation mode will be used. | Internal assessment tests; Students will be given questions that are application based. |

# Syllabus IV Semester

**Paper I/Subject Name : PHARMACEUTICAL ORGANIC CHEMISTRY –III (Theory)**

**L-T-P-C 3–1-0-4** **Credit Units: 4** **Scheme of Evaluation: (T/P/TP)**

**Course Objective:** This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.

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

1. Understand the methods of preparation and properties of organic compounds
2. Explain the stereo chemical aspects of organic compounds and stereo chemical reactions.
3. Know the medicinal uses and other applications of organic compounds
4. Prepare of different organic compounds

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**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I** | **Stereo isomerism**<br>Optical isomerism – Optical activity, enantiomerism, diastereoisomerism, meso compounds Elements of symmetry, chiral and achiral molecules.<br>DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers.Reactions of chiral molecules.<br>Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute | **10 Hours** |
| **II** | Geometrical isomerism. Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems) Methods of determination of configuration of geometrical isomers.Conformational isomerism in Ethane, n-Butane and Cyclohexane.Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity.Stereospecific and stereoselective reactions | **10 Hours** |
| **III** | **Heterocyclic compounds:**<br>Nomenclature and classification. Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrrole, Furan, and Thiophene Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene | **10 Hours** |
| **IV** | Synthesis, reactions and medicinal uses of following compounds/derivatives. Pyrazole, Imidazole, Oxazole and Thiazole. Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives<br>**Reactions of synthetic importance**<br>Metal hydride reduction (NaBH4 and LiAlH4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation | **15 hours** |

**Recommended Books:**

1.Finar I.L. organic chemistry. Volume-I, 6th edition & volume II. 5th edition, Pearson education

2. Bahl, B.S. Bahl.(2017). A text book of organic chemistry. 22nd edition. , S Chand & Company Limited.

3. Bansal Raj K (2008).Heterocyclic Chemistry .4th edition. Anshan Limited

**Reference Book**

4. R. N., Morrison, R. T. (1998). Organic Chemistry. 6th edition.Prentice Hall.

5. Thomas L. Gilchrist (1996). Progress in Heterocyclic Chemistry.3rdedition. Netherlands: Elsevier Science.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | Understand the various properties of organic compounds | Teaching will be conducted both through black board mode and power point presentation mode. | Oral questions will be asked in the class. Students will be given to prepare power point presentation on the assigned topics related to the class teachings. |
| **II** | Explain the stereo chemical aspects of organic compounds and stereo chemical reactions. . | Teaching will be conducted both through black board mode and power point presentation mode. Structure of different organic molecules will be demonstrated by models. | MCQ based assignments will be given to students to check their understanding of the subject. |
| **III** | Students will learn the medicinal uses and other applications of organic compounds | Teaching will be conducted both through black board mode and power point presentation mode. | Problem solving assignments, regular question answer sessions, MCQs and unit-test for internal assessment |
| **IV** | Students will learn about preparation of different organic compounds | Appropriate mix of chalk and board teaching as well as use of Power point presentations for clarity of concepts with reactions, Practical demonstration will be given. | Internal assessment tests will be conducted, – presentations will be assessed along with practical assessment. |

**Paper II/Subject Name : MEDICINAL CHEMISTRY – I (Theory)**

**L-T-P-C –3 -1-2-6** **Credit Units:6** **Scheme of Evaluation: (T/P/TP)**

**Course Objective:** This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity Relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

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

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

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| I | **Introduction to Medicinal Chemistry**<br>**History and development of medicinal chemistry**<br>**Physicochemical properties in relation to biological action:**<br>Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.<br>**Drug metabolism**<br>Drug metabolism principles- Phase I and Phase II.<br>Factors affecting drug metabolism including stereo chemical aspects. | **10 Hours** |
| II | **Drugs acting on Autonomic Nervous System**<br>**Adrenergic Neurotransmitters:**<br>Biosynthesis and catabolism of catecholamine.<br>Adrenergic receptors (Alpha & Beta) and their distribution.<br>**Sympathomimetic agents: SAR of Sympathomimetic agents**<br>Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline.<br>Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine.<br>Agents with mixed mechanism: Ephedrine, Metaraminol.<br>**Adrenergic Antagonists:**<br>**Alpha adrenergic blockers:** Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide.<br>**Beta adrenergic blockers:** SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol. | **10 Hours** |
| III | **Cholinergic neurotransmitters:**<br>Biosynthesis and catabolism of acetylcholine. Cholinergic receptors (Muscarinic & Nicotinic) and their distribution.<br>**Parasympathomimetic agents: SAR of Parasympathomimetic agents**<br>**Direct acting agents:** Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine.<br>**Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible):**<br>Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorphate, Echothiophate iodide, Parathione, Malathion.<br>**Cholinesterase reactivator:** Pralidoxime chloride.<br>**Cholinergic Blocking agents: SAR of cholinolytic agents** | **10 Hours** |

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|---|---|---|
| | **Solanaceous alkaloids and analogues:** Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*.<br>**Synthetic cholinergic blocking agents:** Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride. | |
| IV | **Drugs acting on Central Nervous System**<br>**A. Sedatives and Hypnotics:**<br>**Benzodiazepines:** SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem<br>**Barbiturtes:** SAR of barbiturates, Barbital*, Phenobarbital, Mephobarbital,<br>Amobarbital, Butabarbital, Pentobarbital, Secobarbital<br>**Miscelleneous:**<br>Amides & imides: Glutethmide. Alcohol & their carbamate derivatives: Meprobomate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.<br>**B. Antipsychotics**<br>**Phenothiazeines:** SAR of Phenothiazeines - Promazine hydrochloride Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.<br>**Ring Analogues of Phenothiazeines:** Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine.<br>**Fluro buterophenones:** Haloperidol, Droperidol, Risperidone.<br>**Beta amino ketones:** Molindone hydrochloride.<br>**Benzamides:** Sulpieride.<br>**C. Anticonvulsants:** SAR of Anticonvulsants**,** mechanism of anticonvulsant action<br>**Barbiturates**: Phenobarbitone, Methabarbital. **Hydantoins:**<br>Phenytoin*, Mephenytoin, Ethotoin **Oxazolidine diones:**<br>Trimethadione, Paramethadione **Succinimides:**<br>Phensuximide, Methsuximide, Ethosuximide* **Urea and monoacylureas**: Phenacemide, Carbamazepine*<br>**Benzodiazepines**: Clonazepam<br>**Miscellaneous:** Primidone, Valproic acid , Gabapentin, Felbamate **Drugs acting on Central Nervous System**<br>**General anesthetics:**<br>**Inhalation anesthetics:** Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.<br>**Ultra short acting barbitutrates:** Methohexital sodium*, Thiamylal sodium, Thiopental sodium.<br>**Dissociative anesthetics:** Ketamine hydrochloride.*<br>**Narcotic and non-narcotic analgesics**<br>**Morphine and related drugs:** SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate.<br>**Narcotic antagonists:** Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride. | **15 hours** |

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

**MEDICINAL CHEMISTRY – I (Practical)**

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I** | **I Preparation of drugs/ intermediates**<br>1 1,3-pyrazole<br>2 1,3-oxazole<br>3 Benzimidazole<br>4 Benztriazole<br>5 2,3- diphenyl quinoxaline<br>6 Benzocaine<br>7 Phenytoin<br>8 Phenothiazine<br>9 Barbiturate | **4 Hours/Week** |
| **II** | **I Preparation of drugs/ intermediates:**<br>6 Benzocaine<br>7 Phenytoin<br>8 Phenothiazine<br>9 Barbiturate | **4 Hours/Week** |
| **III** | **II Assay of drugs**<br>1 Chlorpromazine<br>2 Phenobarbitone<br>3 Atropine<br>4 Ibuprofen<br>5 Aspirin<br>6 Furosemide | **4 Hours/Week** |
| **IV** | **Determination of Partition coefficient for any two drugs** | **4 Hours/Week** |

**Recommended Books**

1.Wilson, C. O. (2010). Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry. 12th edition. United Kingdom: Lippincott Williams & Wilkins.

2.Zito, S. W., Foye, W. O., Williams, D. A., Roche, V. F. (2008). Foye's Principles of Medicinal Chemistry.6th edition. United Kingdom: Lippincott Williams & Wilkins.

3.Burger A. (2010). Burger's Medicinal Chemistry, Drug Discovery and Development. United States: Wiley.

4.Smith, H. J., Williams, H. (2005). Smith and Williams' Introduction to the Principles of Drug Design and Action. 4th edition. United Kingdom: Harwood academic publisher,

5.Beringer, P., Remington, J. P. (2006). Remington: The Science and Practice of Pharmacy. 21st edition.United Kingdom: Lippincott Williams & Wilkins.

6.Reynolds, J. E. F., Parfitt, K., Martindale, W. (1993). The Extra Pharmacopoeia. United Kingdom: Pharmaceutical Press.

**Reference Book:**

7. Finar, I. L. (1956). Organic Chemistry, Volume 2: Stereochemistry And The Chemistry Natural Products, 5 edition. India: Pearson Education.

8.Lednicer D. (2007) . The Organic Chemistry of Drug Synthesis. Germany: Wiley. Indian Pharmacopoeia.

9. Furniss B. S. (2004). Practical Organic Chemistry. India: Pearson Education.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | Understand the chemistry of drugs with respect to their pharmacological activity | Chalk and board teaching along with presentations. Class discussions on syllabus topics will be performed. . | Oral questions will be asked in the class. Students will be given to prepare power point presentation on the assigned topics related to the class teachings. |
| **II** | Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs | Teaching will be conducted both through black board mode and power point presentation mode | MCQ based assignments will be given to students to check their understanding of the subject. |
| **III** | Students will learn the Structural Activity Relationship (SAR) of different class of drugs | Teaching will be conducted both through black board mode and power point presentation mode. Structure of different organic molecules will be demonstrated by models. | Problem solving assignments, regular question answer sessions, MCQs and unit-test for internal assessment |
| **IV** | Students will learn about chemical synthesis of some drugs. | Appropriate mix of chalk and board teaching as well as use of Power point presentations for clarity of concepts with reactions, Practical demonstration will be given. | Internal assessment tests will be conducted, – presentations will be assessed along with practical assessment. |

**Paper III/Subject Name : PHYSICAL PHARMACEUTICS-II (Theory)**

**L-T-P-C –3 -1-2-6** **Credit Units:6** **Scheme of Evaluation: (T/P/TP)**

**Course Objective:** The course deals with the various physical and physicochemical properties, and Principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

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

1. Understand various physicochemical properties of drug molecules in the designing the dosage forms
2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms
4. Understand the kinetics of drug degradation and stability of drug.

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I** | **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 | **07 Hours** |
| **II** | **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<br><br>**Deformation of solids:** Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus | **10 Hours** |
| **III** | **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.<br><br>**Micromeretics:** Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties. | **20 hours** |

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|---|---|---|
| **IV** | **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 | **10 hours** |

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**PHYSICAL PHARMACEUTICS- II (Practical)**
**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I** | 1. Determination of particle size, particle size distribution using sieving method<br>2. Determination of particle size, particle size distribution using Microscopic method<br>3. Determination of bulk density, true density and porosity<br>4. Determine the angle of repose and influence of lubricant on angle of repose | **3 Hrs/week** |
| **II** | 5. Determination of viscosity of liquid using Ostwald's viscometer<br>6. Determination sedimentation volume with effect of different suspending agent<br>7. Determination sedimentation volume with effect of different concentration of<br>single suspending agent | **3 Hrs/week** |
| **III** | 8. Determination of viscosity of semisolid by using Brookfield viscometer<br>9. Determination of reaction rate constant first order. | **3 Hrs/week** |
| **IV** | 10. Determination of reaction rate constant second order<br>11. Accelerated stability studies | **3 Hrs/week** |

**Recommended Books: (Latest Editions)**

1.Sinko, P. J., Singh, Y., Martin, A. N. (2011). Martin's Physical Pharmacy and Pharmaceutical Sciences. 6th edition. United Kingdom: Lippincott Williams & Wilkins.
2. Parrott, E. L., Saski, W. (1977). Experimental Pharmaceutics. 4th edition. United States: Burgess Publishing Company.
3. Carter, S. J., Gunn, C., Cooper, J. W. (1975). Cooper and Gunn's Dispensing for Pharmaceutical Students.12th edition. CBS Publishers & Distributors

**Reference Book:**

5. Liberman H.A, Lachman C.( 1989.), Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.
7. Manavalan, R., Ramasamy C. (2017). Physical Pharmaceutics. India: Pharma Med Press.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | Understand various physicochemical properties of drug molecules in the designing the dosage forms | Regular chalk and board teaching along with PPT presentations. Class discussions on syllabus topics will be performed. . | Oral questions will be asked in the class. Students will be given to prepare power point presentation on the assigned topics related to the class teachings. |
| **II** | Students will learn the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations | Teaching will be conducted both through black board mode and power point presentation mode | MCQ based assignments will be given to students to check their understanding of the subject. |
| **III** | Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms | Teaching will be conducted both through black board mode and power point presentation mode. Structure of different organic molecules will be demonstrated by models. | Problem solving assignments, regular question answer sessions, MCQs and unit-test for internal assessment |
| **IV** | Understand the kinetics of drug degradation and stability of drug. | Appropriate mix of chalk and board teaching as well as use of Power point presentations for clarity of concepts with reactions, Practical demonstration will be given. | Internal assessment tests will be conducted, – presentations will be assessed along with practical assessment. |

**Paper IV/Subject Name : PHARMACOLOGY-I (Theory)**

**L-T-P-C –3 -1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Course Objective:** The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (Pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, Contraindications and routes of administration of different classes of drugs.

**Course outcome:** Upon completion of this course the student should be able to
1. Understand the pharmacological actions of different categories of drugs
2. Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.
3. Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
4. Observe the effect of drugs on animals by simulated experiments
5. Appreciate correlation of pharmacology with other bio medical sciences

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I** | **1. General Pharmacology**<br>**a.** 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<br>receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.<br>**b.** Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and<br>excretion of drugs .Enzyme induction, enzyme inhibition, kinetics of elimination | **08 hours** |
| **II** | **General Pharmacology**<br>a. Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories<br>and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor,<br>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.<br>b. Adverse drug reactions.<br>c. Drug interactions (pharmacokinetic and pharmacodynamic)<br>d. Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance | **12 Hours** |
| **III** | **2. Pharmacology of drugs acting on peripheral nervous system**<br>a. Organization and function of ANS.<br>b.Neurohumoral transmission,co-transmission and classification of neurotransmitters.<br>c. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics.<br>d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).<br>e. Local anesthetic agents.<br>f. Drugs used in myasthenia gravis and glaucoma | **10 Hours** |

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|---|---|---|
| **IV** | **3. Pharmacology of drugs acting on central nervous system**<br>a. Neurohumoral transmission in the C.N.S.special emphasis on importance of various<br>neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.<br>b. General anesthetics and pre-anesthetics**.**<br>c. Sedatives, hypnotics and centrally acting muscle relaxants.<br>d. Anti-epileptics<br>e. Alcohols and disulfiram<br>**3. Pharmacology of drugs acting on central nervous system**<br>a. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents,<br>anti-manics and hallucinogens.<br>b. Drugs used in Parkinsons disease and Alzheimer's disease.<br>c. CNS stimulants and nootropics.<br>d. Opioid analgesics and antagonists<br>e. Drug addiction, drug abuse, tolerance and dependence. | **15 Hours** |

*(Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos)*

**PHARMACOLOGY-I (Practical)**

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I** | 1. Introduction to experimental pharmacology.<br>2. Commonly used instruments in experimental pharmacology.<br>3. Study of common laboratory animals.<br>4. Maintenance of laboratory animals as per CPCSEA guidelines. | **4Hrs/week** |
| **II** | 5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.<br>6. Study of different routes of drugs administration in mice/rats.<br>7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.<br>8. Effect of drugs on ciliary motility of frog oesophagus<br>9. Effect of drugs on rabbit eye. | **4Hrs/week** |
| **III** | 10. Effects of skeletal muscle relaxants using rota-rod apparatus.<br>11. Effect of drugs on locomotor activity using actophotometer.<br>12. Anticonvulsant effect of drugs byMES and PTZ method.<br>13. Study of stereotype and anti-catatonic activity of drugs on rats/mice. | **4Hrs/week** |
| **IV** | 14. Study of anxiolytic activity of drugs using rats/mice.<br>15. Study of local anesthetics by different methods | **4Hrs/week** |

*Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos*

**Recommended Books (Latest Editions)**

1.Rang, H. P., Henderson, G., Flower, R. J., Dale, M. M. (2015). Rang&Dale's Pharmacology. 8th edition. United Kingdom**.** Churchil Livingstone Elsevier

2. Katzung B. G., Masters S. B., Trevor A. J.(2013). Basic and clinical pharmacology, 11th edition. New Delhi. Tata McGraw-Hill

3. Laurence L. Brunton et al.(2017). Goodman and Gilman's, The Pharmacological Basis of Therapeutics. 13th edition. Mcgrow hill education.

4. Marry Anne K. K.et al. (2008). Applied Therapeutics, The Clinical use of Drugs. 9th edition .The Point Lippincott Williams &Wilkins

5. Mycek M.J, Gelnet S.B and Perper M.M. (2018). Lippincott's Illustrated Reviews-Pharmacology. 7th edition.

6. Tripathi, K. (2016). Essentials of Medical Pharmacology. 8th edition. India: Jaypee Brothers, Medical Publishers Pvt. Limited

**Reference Book:**

7.Sharma. H. L., Sharma, K. K. (2017). Sharma & Sharma's Principles of Pharmacology. India: Paras Medical Publisher.
8.Stitzel, R. E. (2004). Modern Pharmacology with Clinical Applications. 6th edition. United Kingdom: Lippincott Williams & Wilkins.
9. Ghosh MN.(2015).Fundamentals Of Experimental Pharmacology. India: Hilton & Company.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | Understand the pharmacological actions of different categories of drugs | Regular chalk and board teaching along with PPT presentations. Class discussions on syllabus topics will be performed. | MCQ based assignments will be given to students to check their understanding of the subject. |
| **II** | Students will be ableto explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels. | Teaching will be conducted both through black board mode and power point presentation mode | Oral questions will be asked in the class. Students will be given to prepare power point presentation on the assigned topics related to the class teachings. |
| **III** | Apply the basic pharmacological knowledge in the prevention and treatment of various diseases and students will be able to observe the effect of drugs on animals by simulated experiments | Teaching will be conducted both through black board mode and power point presentation mode. Software's/ Videos will be issued to demonstrate animal experiment. | Problem solving assignments, regular question answer sessions, MCQs and unit-test for internal assessment |
| **IV** | Appreciate correlation of pharmacology with other bio medical sciences | Appropriate mix of chalk and board teaching as well as use of Power point presentations for clarity of concepts with reactions, Practical demonstration will be given. | Internal assessment tests will be conducted, – presentations will be assessed along with practical assessment. |

**Paper V/Subject Name : PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory)**

**L-T-P-C –3 -1-2-6** **Credit Units:6** **Scheme of Evaluation: (T/P/TP)**

**Course Objective:** This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of database.

**Course outcome :** Upon completion of the course, the student shall be able
1. to know the techniques in the cultivation and production of crude drugs
2. to know the crude drugs, their uses and chemical nature
3. know the evaluation techniques for the herbal drugs
4. to carry out the microscopic and morphological evaluation of crude drug

**Detailed syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| I | **Introduction to Pharmacognosy:**<br>(a) Definition, history, scope and development of Pharmacognosy<br>(b) Sources of Drugs – Plants, Animals, Marine & Tissue culture<br>(c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).<br>**Classification of drugs:**<br>Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs<br>**Quality control of Drugs of Natural Origin:**<br>Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties.<br>Quantitative microscopy of crude drugs including lycopodium spore method, leafconstants, camera lucida and diagrams of microscopic objects to scale with camera lucida. | **10 Hrs** |
| II | **Cultivation, Collection, Processing and storage of drugs of natural origin:**<br>Cultivation and Collection of drugs of natural origin<br>Factors influencing cultivation of medicinal plants.<br>Plant hormones and their applications.<br>Polyploidy, mutation and hybridization with reference to medicinal plants<br>**Conservation of medicinal plants** | **10Hrs** |
| III | **Plant tissue culture:**<br>Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance.<br>Applications of plant tissue culture in pharmacognosy.<br>Edible vaccines, Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs<br>**Plant Products:**<br>Fibers - Cotton, Jute, Hemp, Hallucinogens, Teratogens, Natural allergens<br>**Primary metabolites:**<br>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 Primarymetabolites: | **15Hrs** |

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| | **Carbohydrates:** Acacia, Agar, Tragacanth, Honey<br>**Proteins and Enzymes :** Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin).<br>**Lipids(Waxes, fats, fixed oils)** : Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax<br>**Marine Drugs:**<br>Novel medicinal agents from marine sources. | |
| **IV** | **Pharmacognosy in various systems of medicine:**<br>Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine.<br>**Introduction to secondary metabolites:**<br>Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins | **10Hrs** |

**PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)**
**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I** | 1. Analysis of crude drugs by chemical tests: **(**i)Tragaccanth (ii) Acacia (iii)Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil<br>2. Determination of stomatal number and index<br>3. Determination of vein islet number, vein islet termination and paliside ratio. | **4Hrs/week** |
| **II** | 4. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer<br>5. Determination of Fiber length and width<br>6. Determination of number of starch grains by Lycopodium spore method | **4Hrs/week** |
| **III** | 7. Determination of Ash value<br>8. Determination of Extractive values of crude drugs | **4Hrs/week** |
| **IV** | 9. Determination of moisture content of crude drugs<br>10. Determination of swelling index and foaming | **4Hrs/week** |

**Recommended Books:**

1. Evans W.C., Trease and Evans, (2009). Pharmacognosy. 16th edition. . London.W.B. Sounders & Co., London.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E (1988). Text Book of Pharmacognosy. 9th Edition. Lea and Febiger. Philadelphia, T.E. Wallis.
4. Mohammad A.(2019). Textbook of Pharmacognosy. India: CBS Publishers & Distributors.
5. Kokate C.k , Purohit, Gokhlae (2007). Text book of Pharmacognosy. 37th Edition, New Delh: Nirali Prakashan.
6. Choudhary R.D (1996), Herbal drug industry. 1st Edition, NewDelhi: Eastern Publisher.

**Reference Book:**

7. Dr Ansari SH. (2007).Essentials of Pharmacognosy, 2nd edition, New Delhi: Birla publications.
8.Dr. Kokate C.K., Gokhale S.B. . (2008). Practical Pharmacognosy.India: Nirali Prakashan."
9.Iyengar M.A.(1979). Anatomy of Crude Drug. 12th edition. PharmaMed Press

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | Understand the techniques in the cultivation and production of crude drugs | Teaching will be conducted both through black board mode and power point presentation mode | MCQ based assignments will be given to students to check their understanding of the |

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|---|---|---|---|
| | | | subject. |
| **II** | Students will be able to explain the crude drugs, their uses and chemical nature | Teaching will be conducted both through black board mode and power point presentation mode | Oral questions will be asked in the class. Students will be given to prepare power point presentation on the assigned topics related to the class teachings. |
| **III** | Students will learn the evaluation techniques for the herbal drugs | Teaching will be conducted both through black board mode and power point presentation mode. | Problem solving assignments, regular question answer sessions, MCQs and unit-test for internal assessment |
| **IV** | Students will learn to carry out the microscopic and morphological evaluation of crude drugs**.** | Appropriate mix of chalk and board teaching as well as use of Power point presentations for clarity of concepts with reactions, Practical demonstration will be given. | Internal assessment tests will be conducted, – presentations will be assessed along with practical assessment. |

# B. Pharm V Semester

**Paper I/Subject Name: MEDICINAL CHEMISTRY – II (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:** This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

**Course Outcome**: Upon completion of this course the student should be able to
1. Understand the chemistry of drugs with respect to their pharmacological activity
2. Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
3. Know the Structural Activity Relationship of different class of drugs
4. Study the chemical synthesis of selected drugs

**Detailed Syllabus**

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

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Antihistaminic agents:** Histamine, receptors and their distribution in the Human body<br>**$H_1$–antagonists:** Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines cuccinate, Clemastine fumarate, Diphenylphyraline 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<br>**$H_2$-antagonists:** Cimetidine*, Famotidine, Ranitidin.<br>**Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole<br>**Anti-neoplastic agents:**<br>**Alkylating agents:** Meclorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa<br>**Antimetabolites:** Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine,<br>Cytarabine, Methotrexate*, Azathioprine<br>**Antibiotics:** Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin<br>**Plant products:** Etoposide, Vinblastin sulphate, Vincristin sulphate<br>**Miscellaneous:** Cisplatin, Mitotane. | **10 hr** |
| **II.** | **Anti-anginal**:<br>**Vasodilators:** Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbidedinitrite*, Dipyridamole.<br>**Calcium channel blockers:** Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.<br>**Diuretics:**<br>Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide. | **10 hr** |

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| | Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide,<br>Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid.<br>Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride.<br>Osmotic Diuretics: Mannitol<br>**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 | |
| **III.** | **Anti-arrhythmic Drugs**: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol.<br>**Anti-hyperlipidemic agents**: Clofibrate, Lovastatin, Cholesteramine and Cholestipol<br>**Coagulant & Anticoagulants**: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel<br>**Drugs used in Congestive Heart Failure:** Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.. | **11 Hr** |
| **IV** | **Drugs acting on Endocrine system**<br>Nomenclature, Stereochemistry and metabolism of steroids<br>**Sex hormones**: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol.<br>**Drugs for erectile dysfunction:** Sildenafil, Tadalafil.<br>**Oral contraceptives:** Mifepristone, Norgestril, Levonorgestrol<br>**Corticosteroids:** Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone<br>**Thyroid and antithyroid drugs**: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.<br>**Antidiabetic agents:**<br>Insulin and its preparations<br>Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride.<br>Biguanides: Metformin.<br>Thiazolidinediones: Pioglitazone, Rosiglitazone.<br>Meglitinides: Repaglinide, Nateglinide.<br>Glucosidase inhibitors: Acrabose, Voglibose.<br>**Local Anesthetics:** SAR of Local anesthetics<br>**Benzoic Acid derivatives**; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine.<br>**Amino Benzoic acid derivatives**: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate.<br>**Lidocaine/Anilide derivatives**: Lignocaine, Mepivacaine, Prilocaine, Etidocaine.<br>**Miscellaneous**: Phenacaine, Diperodon, Dibucaine.* | **15 hr** |
| **TOTAL** | | **45 hours** |

**Text Books**

1. Wilson and Giswold's (2010). Organic medicinal and Pharmaceutical Chemistry, (Ed. 12th), Wolters Kluwer.
2. Victoria, F. Roche, S. William, Zito, Thomas Lemke, David A. Williams (2019). Foye's Principles of Medicinal Chemistry (Ed. 8th). Wolters Kluwer.

3. Donald J. Abraham, David P. Rotella (2010). Burger's Medicinal Chemistry, Vol I to IV. Wiley Publisher
4. H. John Smith, Hywel Williams (2005). Introduction to principles of drug design (5th Ed.). Taylor & Francis
5. Remington's Pharmaceutical Sciences. 2013; 1st Ed. Pharmaceutical Press.

**Reference Books:**

1. Martindale's extra pharmacopoeia (1996). Pharmaceutical Press;
2. Finar I.L. (2002). Organic Chemistry (Ed. 5th), Vol. II. Pearson Education India
3. Lednicer D. (2007). The Organic Chemistry of Drug Synthesis, Vol. 1to 5. Wiley Press.
4. Indian Pharmacopoeia (2016). Ministry of MHRD. Govt. of India.
5. Vogel A.I. (1989) Text book of practical organic chemistry (Ed. 5th). Prentice Hall.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to explain antihistaminic agents, gastric proton pump inhibitor, anti-neoplastic agents, | Traditional chalk and board teaching and presentations. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Students will be able to explain various antianginal drugs, diuretics, anti-hypertensive drugs | Traditional chalk and board teaching, power point presentations | MCQs, regular discussions Test on structure and functions mentioned drugs |
| III | Students will be able to explain anti-arrhythmic drug, anti-hyperlipidemic antiocoagulant and cardiotonic activity | Traditional teaching and regular discussions and power point presentation on blood and other body fluids | Test and MCQ , assignments. |
| IV | Students will be able to explain drug acting on Endocrine system, antidiabetic drugs, local anaesthetic etc. | Class conduction using board and power point presentation. | Test and MCQ, assignments. |

**Paper II/Subject Name: Industrial Pharmacy I (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:** Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.

**Course Outcome**: Upon completion of this course the student should be able to
1. Know the various pharmaceutical dosage forms and their manufacturing techniques.
2. Know various considerations in development of pharmaceutical dosage forms
3. Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Preformulation Studies:** Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances.<br>***a. Physical properties:*** Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism<br>***b. Chemical Properties:*** Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs & its significant<br>Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms. | **07 hr** |
| **II.** | **Tablets:**<br>a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipment and tablet tooling.<br>b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating.<br>c. Quality control tests: In process and finished product tests<br>**Liquid orals:** Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia | **10 hr** |
| **III.** | **Capsules:**<br>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.<br>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.<br>**Pellets:** Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets | **08 Hr** |

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| IV | **Parenteral Products:**<br>a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity<br>b. Production procedure, production facilities and controls, aseptic processing<br>c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.<br>d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.<br>**Ophthalmic Preparations:** Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations<br>**Cosmetics:** Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.<br>**Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.<br>**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. | **20 hr** |
| **TOTAL** | | **45 hours** |

## Industrial Pharmacy I (Practical)

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | 1. Preformulation studies on paracetamol/asparin/or any other drug.<br>2. Preparation and evaluation of Paracetamol tablets<br>3. Preparation and evaluation of Aspirin tablets | **4hr/wk** |
| **II.** | 4. Coating of tablets- film coating of tables/granules<br>5. Preparation and evaluation of Tetracycline capsules<br>6. Preparation of Calcium Gluconate injection. | **4 hr/wk** |
| **III.** | 7. Preparation of Ascorbic Acid injection<br>8. Quality control test of (as per IP) marketed tablets and capsules | **4 hr/wk** |
| **IV** | 9. Preparation of Eye drops/ and Eye ointments.<br>10. Preparation of Creams (cold / vanishing cream)<br>11. Evaluation of Glass containers (as per IP) | **4 hr/wk** |
| **TOTAL** | | **60 hours** |

**Text Book:**

**1.** Liberman H.A., Lachman L, Schwartz J.B. (2012). Pharmaceutical dosage forms - Tablets, volume 1 -3. CRC Press.

**2.** Liberman H.A., Lachman L, (2012). Pharmaceutical dosage form - Parenteral medication vol-1&2. CRC Press.

**3.** Liberman H.A., Lachman L, (2012). Pharmaceutical dosage form disperse system VOL-1. CRC Press.

**4.** Gilbert S. B, Rhodes C.T., (2010). Modern Pharmaceutics. 3rd Edition. Marcel Dekker, Inc.

**5.** Liberman H.A., Lachman L, (2012). Theory and Practice of Industrial Pharmacy. 4th Ed. CBS Publishers.

**Recommended Books:**

1. Adeboye A. (2020). Remington: The Science and Practice of Pharmacy. 23rd Ed. Academic Press
2. Aulton, M.E. (2020) Pharmaceutics- The science of dosage form design. 18th Ed. Churchill Livingstone.
3. Ansel H.C., (2005). Introduction to Pharmaceutical Dosage Forms. 5th Ed. Academic Press.
4. Cartensen, C.J. Rhodes (2015). Drug stability - Principles and practice. Vol 107; 3rd Ed. Marcel Dekker Series.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to explain preformulation studies of different dosage forms | Traditional chalk and board teaching and presentations. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Students will be able to explain about types, classification, formulation of tablets.<br>They will also learn about formulation and manufacturing of liquid orals | Traditional chalk and board teaching, power point presentations | MCQs, regular discussions Test on structure and functions mentioned drugs |
| III | Students will be able to explain explain about types, classification, formulation of capsules | Traditional teaching and regular discussions and power point presentation capsules | Test and MCQ , assignments. |
| IV | Students will be able to explain about types, classification, formulation of various parentral products, ophthalmic preparations and cosmetics | Class conduction using board and power point presentation. | Test and MCQ, assignments. |

| Paper III/Subject Name: Pharmacology-II (Theory) | | |
|---|---|---|
| **L-T-P-C – 3-1-2-6** | **Credit Units: 6** | **Scheme of Evaluation: (T/P/TP)** |

**Objective:** This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition, emphasis on the basic concepts of bioassay.

**Course Outcome**: Upon completion of this course the student should be able to
1. Understand the mechanism of drug action and its relevance in the treatment of different diseases.
2. Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments
3. Demonstrate the various receptor actions using isolated tissue preparation.
4. Appreciate correlation of pharmacology with related medical sciences

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Pharmacology of drugs acting on cardio vascular system**<br>a. Introduction to hemodynamic and electrophysiology of heart.<br>b. Drugs used in congestive heart failure<br>c. Anti-hypertensive drugs.<br>d. Anti-anginal drugs.<br>e. Anti-arrhythmic drugs.<br>f. Anti-hyperlipidemic drugs. | **10 hr** |
| **II.** | **Pharmacology of drugs acting on cardio vascular system**<br>a. Drug used in the therapy of shock.<br>b. Hematinics, coagulants and anticoagulants.<br>c. Fibrinolytics and anti-platelet drugs<br>d. Plasma volume expanders<br>**2. Pharmacology of drugs acting on urinary system**<br>a. Diuretics<br>b. Anti-diuretics. | **10 hr** |
| **III.** | **Autocoids and related drugs**<br>a. Introduction to autacoids and classification<br>b. Histamine, 5-HT and their antagonists.<br>c. Prostaglandins, Thromboxanes and Leukotrienes.<br>d. Angiotensin, Bradykinin and Substance P.<br>e. Non-steroidal anti-inflammatory agents<br>f. Anti-gout drugs<br>g. Antirheumatic drugs | **10 Hr** |

| | | |
|---|---|---|
| **IV** | **Pharmacology of drugs acting on endocrine system**<br>a. Basic concepts in endocrine pharmacology.<br>b. Anterior Pituitary hormones- analogues and their inhibitors.<br>c. Thyroid hormones- analogues and their inhibitors.<br>d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D.<br>d. Insulin, Oral Hypoglycemic agents and glucagon.<br>e. ACTH and corticosteroids<br>**Pharmacology of drugs acting on endocrine system**<br>a. Androgens and Anabolic steroids.<br>b. Estrogens, progesterone and oral contraceptives.<br>c. Drugs acting on the uterus.<br>**6. Bioassay**<br>a. Principles and applications of bioassay.<br>b.Types of bioassay<br>c. Bioassay of insulin, oxytocin, vasopressin, ACTH, d tubocurarine, digitalis, histamine and 5-HT | **15 hr** |
| **TOTAL** | | **45 hours** |

**PHARMACOLOGY-II (Practical)**
**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | 1. Introduction to *in-vitro* pharmacology and physiological salt solutions.<br>2. Effect of drugs on isolated frog heart.<br>3. Effect of drugs on blood pressure and heart rate of dog.<br>4. Study of diuretic activity of drugs using rats/mice. | **4hr/wk** |
| **II.** | 5. DRC of acetylcholine using frog rectus abdominis muscle.<br>6. Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively.<br>7. Bioassay of histamine using guinea pig ileum by matching method.<br>8. Bioassay of oxytocin using rat uterine horn by interpolation method | **4 hr/wk** |
| **III.** | 8. Bioassay of serotonin using rat fundus strip by three point bioassay.<br>9. Bioassay of acetylcholine using rat ileum/colon by four point bioassay.<br>10. Determination of $PA_2$ value of prazosin using rat anococcygeus muscle (by Schilds plot method).<br>11. Determination of $PD_2$ value using guinea pig ileum | **4 hr/wk** |
| **IV** | 12. Effect of spasmogens and spasmolytics using rabbit jejunum.<br>13. Anti-inflammatory activity of drugs using carrageenan induced paw-edema model.<br>14. Analgesic activity of drug using central and peripheral methods | **4 hr/wk** |
| **TOTAL** | | **60 hours** |

*Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos*

**Test Books:**

**1.** Rang H.P., Dale M.M., Ritter J.M., Flower R.J. (2015). Rang and Dale's Pharmacology, Churchill Livingstone Elsevier.

**2.** Katzung B.G., Masters S.B., Trevor A.J. (2015). Basic and clinical pharmacology, Tata Mc Graw-Hill.
**3.** Brunton L.L., Hilal-Dandan R., Knollmann B.C. (2018). Goodman and Gilman's, The Pharmacological Basis of Therapeutics. 13th Ed. McGraw-Hill Education.
**4.** Kulkarni S.K. (2002). Handbook of experimental pharmacology. Vallabh Prakashan, New Delhi.
**5.** Tripathi K.D. (2017). Essentials of Medical Pharmacology. JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.

**Recommended Books**

1. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W. (2012). Applied Therapeutics, The Clinical use of Drugs. The Point Lippincott Williams & Wilkins.
2. Mycek M.J, Gelnet S.B and Perper M.M. (2016). Lippincott's Illustrated Reviews- Pharmacology.
3. Sharma H. L., Sharma K. K. (2010). Principles of Pharmacology. Paras medical publisher
4. Charles R.C., Robert E (2010). Modern Pharmacology with clinical Applications. Lippincott Williams & Wilkins.
5. Ghosh MN (2010). Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to explain Pharmacology of drugs acting on cardio vascular system like congestive heart failure, anti-hypertensive, anti-anginal, anti-arrhythmic and anti-hyperlipidemic agents. | Traditional chalk and board teaching and presentations. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Students will be able to explain about therapy of shock, anticoagulan0ts, fibrinolytics, anti-platelet drugs etc. They will also learn about drugs acting on urinary system | Traditional chalk and board teaching, power point presentations | MCQs, regular discussions Test on structure and functions mentioned drugs |
| III | Students will be able to explain autocoids and related drugs like histaminics, prostaglandins, anti-gout drugs, anti-rheumatic drugs | Traditional teaching and regular discussions and power point presentation | Test and MCQ , assignments. |
| IV | Students will be able to explain about Pharmacology of drugs acting on endocrine system, bio-assays of various drugs | Class conduction using board and power point presentation. | Test and MCQ, assignments. |

**Paper IV/Subject Name: Pharmacognosy and Phytochemistry II (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:** The main purpose of subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and phytochemicals through plant tissue culture, drug interactions and basic principles of traditional system of medicine.

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

1. know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents
2. understand the preparation and development of herbal formulation.
3. understand the herbal drug interactions
4. carryout isolation and identification of phytoconstituents

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Metabolic pathways in higher plants and their determination**<br>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.<br>b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies. | **07 hr** |
| **II.** | General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following<br>secondary metabolites:<br>**Alkaloids:** Vinca, Rauwolfia, Belladonna, Opium,<br>**Phenylpropanoids and Flavonoids:** Lignans, Tea, Ruta<br>**Steroids, Cardiac Glycosides & Triterpenoids**: Liquorice, Dioscorea, Digitalis<br>**Volatile oils**: Mentha, Clove, Cinnamon, Fennel, Coriander,<br>**Tannins:** Catechu, Pterocarpus<br>**Resins:** Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony<br>**Glycosides:** Senna, Aloes, Bitter Almond<br>**Iridoids, Other terpenoids & Naphthaquinones:** Gentian, Artemisia, taxus, carotenoids | **14 hr** |
| **III.** | **Isolation, Identification and Analysis of Phytoconstituents**<br>**a) Terpenoids**: Menthol, Citral, Artemisin<br>**b) Glycosides**: Glycyrhetinic acid & Rutin<br>**c) Alkaloids**: Atropine,Quinine,Reserpine,Caffeine<br>**d) Resins**: Podophyllotoxin, Curcumin | **06 hr** |
| **IV** | **Industrial production, estimation and utilization of the following phytoconstituents**:<br>Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine<br>**Basics of Phytochemistry**<br>Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs. | **18 hr** |
| **TOTAL** | | **45 hr** |

**PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical)**

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | 1. Morphology, histology and powder characteristics & extraction & detection of:<br>Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander | **4hr/wk** |
| **II.** | 2. Exercise involving isolation & detection of active principles<br>a. Caffeine - from tea dust.<br>b. Diosgenin from Dioscorea<br>c. Atropine from Belladonna<br>d. Sennosides from Senna | **4 hr/wk** |
| **III.** | 3. Separation of sugars by Paper chromatography<br>4. TLC of herbal extract | **4 hr/wk** |
| **IV** | 5. Distillation of volatile oils and detection of phytoconstitutents by TLC<br>6. Analysis of crude drugs by chemical tests: **(**i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh. | **4 hr/wk** |
| **TOTAL** | | **60 hours** |

**Text Books:**

1. Evans W.C. (2009). Trease and Evans Pharmacognosy. 16th Ed, W.B. Sounders & Co., London.
2. Mohammad Ali (2014). Pharmacognosy and Phytochemistry. CBS Publishers & Distribution, New Delhi.
3. Kokate C.K., Purohit A.P., Gokhlae S.B. (2019). Text book of Pharmacognosy, 50th Ed, Nirali Prakashan, New Delhi.
4. Choudhary R.D. (1996). Herbal drug industry. 1st Ed, Eastern Publisher, New Delhi.
5. Ansari S.H. (2007). Essentials of Pharmacognosy. 2nd Ed, Birla publications, New Delhi,
6. Pande H. (2010). Herbal Cosmetics. Asia Pacific Business press, Inc, New Delhi.
7. Kalia A.N. (2005). Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi.

**Recommended Books:**

1. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
2. James B., Marilyn K.S., Tylor V.E. (1996). Pharmacognosy & Pharmacobiotechnology. Lippincott Williams and Wilkins.
3. Lous A. (1994). The formulation and preparation of cosmetic, fragrances and flavours. Micelle Press;
4. Remington's Pharmaceutical sciences. 2016; John Wiley & Sons; 18th Revised Ed.
5. Vyas S.P., Dixit V.K. (2019). Text Book of Biotechnology. CBS Publishers, India
6. Dubey R.C., Chand S. (2006). Text Book of Biotechnology; 4th Ed.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to explain Metabolic pathways in higher plants and their determination. | Traditional chalk and board teaching and presentations. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |

| | | | |
|---|---|---|---|
| II. | Students will be able to explain about introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of alkaloids, glycosides, flavonoids, volatile oils, tannins, resins, glycosides etc. | Traditional chalk and board teaching, power point presentations | MCQs, regular discussions Test on structure and functions mentioned drugs |
| III | Students will be able to explain Isolation, Identification and Analysis of Phytoconstituents like alkaloids, glycosides, flavonoids, volatile oils, tannins, resins, glycosides | Traditional teaching and regular discussions and power point presentation | Test and MCQ , assignments. |
| IV | Students will be able to explain about Industrial production, estimation and utilization of the various phytoconstituents.<br>Students will also know Modern methods of extraction, isolation by chromatographic techniques and characterization by spectroscopic analysis | Class conduction using board and power point presentation. | Test and MCQ, assignments. |

**Paper IV/Subject Name: Pharmaceutical Jurisprudence (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:** This course is designed to impart basic knowledge on important legislations related to the profession of pharmacy in India..

**Course Outcome**: Upon completion of this course the student should be able to undrstand
1. The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.
2. Various Indian pharmaceutical Acts and Laws
3. The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
4. The code of ethics during the pharmaceutical practice

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Drugs and Cosmetics Act, 1940 and its rules 1945:**<br>Objectives, Definitions, Legal definitions of schedules to the Act and Rules<br>Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties**.**<br>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. | **10 hr** |
| **II.** | **Drugs and Cosmetics Act, 1940 and its rules 1945.**<br>Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA)<br>Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties<br>Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties.<br>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 | **10 hr** |
| **III.** | **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<br>• **Medicinal and Toilet Preparation Act –1955**: Objectives, Definitions, Licensing,<br>Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations.<br>Offences and Penalties.<br>• **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 | **10 Hr** |

| | | |
|---|---|---|
| | and export of opium, Offences and Penalties | |
| **IV** | **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<br>• **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<br>• **National Pharmaceutical Pricing Authority:** Drugs Price Control Order (DPCO) - 2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations,<br>Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM)<br>**Pharmaceutical Legislations –** A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee<br>• **Code of Pharmaceutical ethics** D efinition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath<br>• **Medical Termination of Pregnancy Act**<br>• **Right to Information Act**<br>• **Introduction to Intellectual Property Rights (IPR)** | **15 hr** |
| **TOTAL** | | **45 hours** |

**Text Books:**


1. Suresh B. (2010). Forensic Pharmacy; 1st Ed. Birla Publishers.
2. Mithal B.M. (2020). Text book of Forensic Pharmacy by; Vallabh Prakashan
3. Mehra M.L., (2002). Hand book of drug law. Universal Book Traders, Delhi
4. Jain N.K., (2002). A text book of Forensic Pharmacy. Vallabh Prakashan, New Delhi.


**Recommended books:**


1. Drugs and Cosmetics Act/Rules by Govt. of India publications.
2. Medicinal and Toilet preparations act 1955 by Govt. of India publications.
3. Narcotic drugs and psychotropic substances act by Govt. of India publications
4. Drugs and Magic Remedies act by Govt. of India publication
5. Bare Acts of the said laws published by Government. Reference books (Theory)

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to explain Drugs and Cosmetics Act, 1940 and its rules 1945 | Traditional chalk and board teaching and presentations. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question and answer session. |
| II. | Students will be able to explain Drugs and Cosmetics Act, 1940 and its rules 1945 | Traditional chalk and board teaching, power point presentations. | MCQs, regular discussions, internal assessments, regular question and answer session |
| III | Students will be able to explain pharmacy act 1948, Medicinal and Toilet Preparation Act –1955, Narcotic Drugs and Psychotropic substances Act-1985 and Rules. | Traditional teaching and regular discussions | Test and MCQ , assignments. |
| IV | Students will be able to study of Salient Features of Drugs and Magic Remedies Act and its rules, Prevention of Cruelty to animals Act-1960, National Pharmaceutical Pricing Authority. | Class conduction using board and power point presentation. | Test and MCQ , assignments. |

# B. Pharm VI Semester

**Paper I/Subject Name: MEDICINAL CHEMISTRY – III (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:** This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of rational drug design like quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry and Computer aided drug design (CADD). The subject also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important
drugs.

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

1. Understand the importance of drug design and different techniques of drug design.
2. Understand the chemistry of drugs with respect to their biological activity.
3. Know the metabolism, adverse effects and therapeutic value of drugs.
4. Know the importance of SAR of drugs.

**Detailed Syllabus**

**Course Content:**

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

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| I. | **Antibiotics**<br>Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.<br>**β-Lactam antibiotics:** Penicillin, Cepholosporins, β- Lactamase inhibitors, Monobactams<br>**Aminoglycosides:** Streptomycin, Neomycin, Kanamycin<br>**Tetracyclines:** Tetracycline,Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline | **10 hr** |
| II. | **Antibiotics**<br>Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes<br>**Macrolide:** Erythromycin Clarithromycin, Azithromycin.<br>**Miscellaneous:** Chloramphenicol*, Clindamycin.<br>**Prodrugs:** Basic concepts and application of prodrugs design.<br>**Antimalarials:** Etiology of malaria.<br>**Quinolines:** SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine.<br>**Biguanides and dihydro triazines:** Cycloguanil pamoate, Proguanil.<br>**Miscellaneous:** Pyrimethamine, Artesunete, Artemether, Atovoquone. | **10 hr** |

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|---|---|---|
| **III.** | **Anti-tubercular Agents**<br>**Synthetic anti tubercular agents:** Isoniozid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.*<br>**Anti tubercular antibiotics:** Rifampicin, Rifabutin, Cycloserine Streptomycine, Capreomycin sulphate.<br>**Urinary tract anti-infective agents**<br>**Quinolones:** SAR of quinolones, Nalidixic Acid,Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin<br>**Miscellaneous:** Furazolidine, Nitrofurantoin*, Methanamine.<br>**Antiviral agents:**<br>Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir. | **10Hr** |
| **IV** | **Antifungal agents:**<br>**Antifungal antibiotics:** Amphotericin-B, Nystatin, Natamycin, Griseofulvin.<br>**Synthetic Antifungal agents:** Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconozole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*.<br>**Anti-protozoal Agents:** Metronidazole*, Tinidazole, Ornidazole, Diloxanide,<br>Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine.<br>**Anthelmintics:** Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*,<br>Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin.<br>**Sulphonamides and Sulfones**<br>Historical development, chemistry, classification and SAR of Sulfonamides:<br>Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxaole*, Sulphadiazine, Mefenide acetate, Sulfasalazine.<br>**Folate reductase inhibitors:** Trimethoprim*, Cotrimoxazole.<br>**Sulfones:** Dapsone*. **Introduction to Drug Design**<br>Various approaches used in drug design.<br>Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis.<br>Pharmacophore modeling and docking techniques.<br>**Combinatorial Chemistry:** Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis. | **15 hr** |
| **TOTAL** | | **45 hours** |

**BP607P. MEDICINAL CHEMISTRY- III (Practical)**

**4 Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | 1. **Preparation of drugs and intermediates**<br>1 Sulphanilamide<br>2 7-Hydroxy, 4-methyl coumarin<br>3 Chlorobutanol | **4hr/wk** |

| | | |
|---|---|---|
| | 4 Triphenyl imidazole<br>5 Tolbutamide<br>6 Hexamine | |
| **II.** | **Assay of drugs**<br>7 Isonicotinic acid hydrazide<br>8 Chloroquine<br>9 Metronidazole<br>10 Dapsone<br>11Chlorpheniramine maleate<br>12Benzyl penicillin | **4 hr/wk** |
| **III.** | Preparation of medicinally important compounds or intermediates byMicrowave irradiation technique | **4 hr/wk** |
| **IV** | Drawing structures and reactions using chem draw® | **4 hr/wk** |
| **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 (Lipinskies RO5) | **4 hr/wk** |
| **TOTAL** | | **60hours** |

**Text Book:**

1Wilson and Giswold (2012). Organic medicinal and Pharmaceutical Chemistry,11th edition, Lipinkott
Williams and Wilkins.
2. Smith and Williams (2005), Introduction to principles of drug design, 4th edition. CRC Press. 3.
Joseph Price Remington and Alfonso R. Gennaro(2000), Remington's Pharmaceutical Sciences, 20th
edition. Lippincott Williams and Wilkins.
3. William Martindale & William Harrison (2017), Martindale's extra pharmacopoeia, 39th edition. Wentworth Press.
4. Organic Chemistry by I.L. Finar, Vol. II(1988), 5th edition. Longman publisher
5. Daniel Lednicer (1998); The Organic Chemistry of Drug Synthesis, 6th edition ,Wiley– Blackwell.
6. Indian Pharmacopoeia (2005), The Indian Pharmacopoeia Commission.
7. A.I.Vogel & A.R. Tatchell (1989), Text book of practical organic chemistry, 5th edition, Prentice Hall

**Reference Books:**

1. Victoria, F. Roche(2019), Foye's Principles of Medicinal Chemistry, 8th edition, Wolters Kluver
2. Donald J. Abraham David P. Rotella(2010), Burger's Medicinal Chemistry, Vol I to IV,7th edition, Wiley

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to understand drug design and different techniques of drug design. | Traditional chalk and board teaching and presentations,hands-on- Microscopic study of epithelial and connective tissue, muscular and nervous tissue. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Describe the chemistry of drugs with respect to their biological activity | Traditional chalk and board teaching, power point presentations, laboratory based identification | MCQs, regular discussions Test on structure and functions of the organ system |
| III | Students will be able to understand the metabolism, adverse effects and therapeutic value of drugs. | Traditional teaching and regular discussions and power point presentation on blood and other body fluids | Test and MCQ , assignments. |
| IV | Students will be able to understand the importance of SAR of drugs | Class conduction using board and power point presentation. | Test and MCQ , assignments. |

**Paper I/Subject Name: PHARMACOLOGY-III (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:** This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology and in addition,emphasis on the principles of toxicology and chronopharmacology drugs.

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

1.Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases

2. Comprehend the principles of toxicology and treatment of various poisonings and

3. Appreciate correlation of pharmacology with related medical sciences.

4. Understand the basic concept of toxicology and poisoning with their treatment

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **1. Pharmacology of drugs acting on Respiratory system**<br>a. Anti -asthmatic drugs<br>b. Drugs used in the management of COPD<br>c. Expectorants and antitussives<br>d. Nasal decongestants<br>e. Respiratory stimulants<br>**2. Pharmacology of drugs acting on the Gastrointestinal Tract**<br>a. Antiulcer agents.<br>b. Drugs for constipation and diarrhoea.<br>c. Appetite stimulants and suppressants.<br>d. Digestants and carminatives.<br>e. Emetics and anti-emetics. | **10 hr** |
| **II.** | **Chemotherapy**<br>a. General principles of chemotherapy.<br>b. Sulfonamides and cotrimoxazole.<br>c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides. | **10 hr** |
| **III.** | **3. Chemotherapy**<br>a. Antitubercular agents, b. Antileprotic agents c. Antifungal agents<br>d. Antiviral drugs, e.Anthelmintics, f. Antimalarial drugs<br>g. Antiamoebic agents | **10 Hr** |
| **IV** | **3. Chemotherapy**<br>l. Urinary tract infections and sexually transmitted diseases.<br>m. Chemotherapy of malignancy.<br>**4. Immunopharmacology**<br>a. Immunostimulants<br>b. Immunosuppressant<br>Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars<br>**5. Principles of toxicology**<br>**a.** Definition and basic knowledge of acute, subacute and chronic toxicity.<br>**b.** Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity<br>and mutagenicity | **15 hr** |

| | | |
|---|---|---|
| | **c.** General principles of treatment of poisoning<br>**d.** Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning.<br>**6. Chronopharmacology**<br>a. Definition of rhythm and cycles.<br>b. Biological clock and their significance leading to chronotherapy. | |
| **TOTAL** | | **45 hours** |

**BP607P. BP 608 P. PHARMACOLOGY-III (Practical)**

**4 Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | 1.Dose calculation in pharmacological experiments<br>2. Antiallergic activity by mast cell stabilization assay<br>3. Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model.<br>4. Study of effect of drugs on gastrointestinal motility | **4hr/wk** |
| **II.** | 5. Effect of agonist and antagonists on guinea pig ileum<br>6. Estimation of serum biochemical parameters by using semi- autoanalyser<br>7. Effect of saline purgative on frog intestine<br>8. Insulin hypoglycemic effect in rabbit | **4 hr/wk** |
| **III.** | 9. Test for pyrogens ( rabbit method)<br>10. Determination of acute oral toxicity (LD50) of a drug from a given data<br>11. Determination of acute skin irritation / corrosion of a test substance<br>12. Determination of acute eye irritation / corrosion of a test substance<br>13. Calculation of pharmacokinetic parameters from a given data | **4 hr/wk** |
| **IV** | 13. Calculation of pharmacokinetic parameters from a given data<br>14. Biostatistics methods in experimental pharmacology( student's t test, ANOVA)<br>15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test) | **4 hr/wk** |
| **TOTAL** | | **60hours** |

**Text Book:**


1.Rang H. P., Dale M. M., Ritter J. M., Flower R. J.(2019), Rang and Dale's Pharmacology,9th edition, Relx India Pvt. Ltd.

2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology(2009), edition 11 Tata Mc Graw-Hill Medical.

3. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology(2018), 4th edition, Wolters Kluwer India Pvt. Ltd.

4. K.D.Tripathi. Essentials of Medical Pharmacology(2018), edition 8th , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.

5. Sharma H. L., Sharma K. K., (2017) Principles of Pharmacology, edition 3, Paras medical publisher 6. Ghosh M.N. (2019). Fundamentals of Experimental Pharmacology, 3rd edition Hilton & Company, Kolkata,

7. Kulkarni SK(2014). Handbook of experimental pharmacology,4th edition, VallabhPrakashan.

8. Udupa N. and Gupta.P.D.(2009), Concepts in Chronopharmacology.1st edition, Shyam Prakashan Publishers


**Reference Books:**


1. Goodman and Gilman. (2017), The Pharmacological Basis of Therapeutics, 13th edition, McGraw-

Hill Education.
2. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W.(2017), Applied Therapeutics, The Clinical use of Drugs, 11th edition, The Point Lippincott Williams &Wilkins.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to understand the mechanism of drug action and its relevance in the treatment of different infectious diseases | Traditional chalk and board teaching and presentations,hands-on- Microscopic study of epithelial and connective tissue, muscular and nervous tissue. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Students will comprehend the principles of toxicology and treatment of various poisonings | Traditional chalk and board teaching, power point presentations, laboratory based identification | MCQs, regular discussions Test on structure and functions of the organ system |
| III | Students will appreciate correlation of pharmacology with related medical sciences. | Traditional teaching and regular discussions and power point presentation on blood and other body fluids | Test and MCQ , assignments. |

**Paper I/Subject Name: HERBAL DRUG TECHNOLOGY (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:** This subject gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The subject also emphasizes on Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs

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

1. understand raw material as source of herbal drugs from cultivation to herbal drug product
2. know the WHO and ICH guidelines for evaluation of herbal drugs
3. know the herbal cosmetics, natural sweeteners, nutraceuticals
4. appreciate patenting of herbal drugs, GMP .

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Herbs as raw materials**<br>Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation<br>Source of Herbs<br>Selection, identification and authentication of herbal materials<br>Processing of herbal raw material<br>**Biodynamic Agriculture**<br>Good agricultural practices in cultivation of medicinal plants including Organic farming.<br>Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.<br>**Indian Systems of Medicine**<br>a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy<br>b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas,<br>Ghutika,Churna, Lehya and Bhasma. | **11 hr** |
| **II.** | **Nutraceuticals**<br>General aspects, Market, growth, scope and types of products available in the market. Health<br>benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable<br>bowel syndrome and various Gastro intestinal diseases.<br>Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic,<br>Honey, Amla, Ginseng, Ashwagandha, Spirulina<br>**Herbal-Drug and Herb-Food Interactions:** General introduction to interaction and<br>classification. Study of following drugs and their possible side effects and interactions:<br>Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra. | **7 hr** |
| **III.** | **Herbal Cosmetics**<br>Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums<br>colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin<br>care, hair care and oral hygiene products.<br>**Herbal excipients:**<br>Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants,<br>flavors & perfumes.<br>**Herbal formulations :** | **10 Hr** |

| | | |
|---|---|---|
| | Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes | |
| **IV** | **Evaluation of Drugs** WHO & ICH guidelines for the assessment of herbal drugs<br>Stability testing of herbal drugs.<br>**Patenting and Regulatory requirements of natural products:**<br>a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy<br>b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem.<br>**Regulatory Issues** - Regulations in India (ASU DTAB, ASU DCC),<br>Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs<br>Herbal drugs industry: Present scope and future prospects.<br>A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.<br>S**chedule T – GoodManufacturing Practice of Indian systems of medicine**<br>Components of GMP (Schedule – T) and its objectives<br>Infrastructural requirements, working space, storage area, machinery and equipments,<br>standard operating procedures, health and hygiene, documentation and records. | **17 hr** |
| **TOTAL** | | **45 hours** |

## BP 609 P. HERBAL DRUG TECHNOLOGY (Practical)

**4 Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | 1.To perform preliminary phytochemical screening of crude drugs. | **4hr/wk** |
| **II.** | 2.Determination of the alcohol content of Asava and Arista<br>3. Evaluation of excipients of natural origin | **4 hr/wk** |
| **III.** | 4.Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.<br>5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements. | **4 hr/wk** |
| **IV** | 7.Determination of Aldehyde content<br>8. Determination of Phenol content<br>9. Determination of total alkaloids | **4 hr/wk** |
| **TOTAL** | | **60hours** |

**Text Book:**

1. Kokate C.K., Purohit and Gokhale A.P.(2008), Pharmacognosy, 55th edition, Nirali Prakashan.
2. Ansari S.H. (2016), Essential of Pharmacognosy, 6th edition, Birla publications pvt. Ltd.
3.Rangari V.D. (2009), Pharmacognosy & Phytochemistry,2nd edition, Career Publications.
4. Tyler V.E., Brady L. & Robber J.(1999), Textbook of Pharmacognosy,1st edition, Routledge;

**Reference Books:**

1. Evans W.C.(2009), Trease and Evans Pharmacognosy.16th edition, Elsevier Health - UK

2. Council of Research in Indian Medicine & Homeopathy (1987), Pharmacopoeal standards for Ayurvedic Formulation, National government publication.
3. Mukherjee P. K.(2002), Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. edition Business Horizons Publishers, New Delhi, India, 2002.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to understand raw material as source of herbal drugs from cultivation to herbal drug product | Traditional chalk and board teaching and presentations,hands-on- Microscopic study of epithelial and connective tissue, muscular and nervous tissue. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Students will be able to know the WHO and ICH guidelines for evaluation of herbal drugs. | Traditional chalk and board teaching, power point presentations, laboratory based identification | MCQs, regular discussions Test on structure and functions of the organ system |
| III | Students will be able to know the herbal cosmetics, natural sweeteners, nutraceuticals | Traditional teaching and regular discussions and power point presentation on blood and other body fluids | Test and MCQ , assignments. |
| IV | Students will be able to appreciate patenting of herbal drugs, GMP | Class conduction using board and power point presentation. | Test and MCQ , assignments. |

**Paper I/Subject Name: BIOPHARMACEUTICS AND PHARMACOKINETICS**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:** This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems arised therein.

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

1. Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
2. Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
3. To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
4. Understand various pharmacokinetic parameters, their significance & applications..

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Introduction to Biopharmaceutics**<br>**Absorption**; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes, **Distribution** Tissue permeability of drugs, binding of drugs, apparent, 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 | **10 hr** |
| **II.** | **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<br>**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. | **10 hr** |
| **III.** | **Pharmacokinetics:** Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - $K_E$ ,t1/2,Vd,AUC,Ka, Clt and $CL_R$- definitions methods of eliminations, understanding of their significance and application | **10 Hr** |
| **IV** | ***Multicompartment models:*** Two compartment open model. IV bolus<br>Kinetics of multiple dosing, steady state drug levels, calculation of loading and mainetnance doses and their significance in clinical settins<br>**Nonlinear Pharmacokinetics:** a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.standard operating procedures, health and hygiene, documentation and records. | **15 hr** |
| **TOTAL** | | **45 hours** |

**Text Book:**

1. Gibaldi M.(2005), Biopharmaceutics and Clinical Pharmacokinetics, 4th edition, Pharma Book Syndicate.

2. Robert F. N. (2019), Biopharmaceutics and Pharmacokinetics; 4th edition, CBS Publishers & Distributors.
3. Shargel L. Andrew B.C. (2016) , Applied biopharmaceutics and pharmacokinetics,7th edition, McGraw-Hill Education.
4. Brahmankar D. M. and Jaiswa S. B. (2015), Bio pharmaceutics and Pharmacokinetics-A Treatise, 3rd editionVallabh Prakashan Pitampura, Delhi.
5. Donald M.G., Dekker R.M. (1982), Pharmacokinetics, 2nd edition, Pharma Book Syndicate.
6. Abdou H.M, Mack (1989), Dissolution, Bioavailability and Bioequivalence,edition, Publishing Company,Pennsylvania.

**Reference Books:**

1. Rebort F Notari Marcel Dekker Inn(1987), Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition, New York and Basel.
2. Remington J.P. (2000), Pharmaceutical Sciences, 20th edition, Lippincott Williams and Wilkins.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance. | Traditional chalk and board teaching and presentations,hands-on- Microscopic study of epithelial and connective tissue, muscular and nervous tissue. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Students will be able to understand the use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination. | Traditional chalk and board teaching, power point presentations, laboratory based identification | MCQs, regular discussions Test on structure and functions of the organ system |
| III | Students will be able to understand the concepts of bioavailability and bioequivalence of drug products and their significance. | Traditional teaching and regular discussions and power point presentation on blood and other body fluids | Test and MCQ , assignments. |
| IV | Students will be able to understand various pharmacokinetic parameters, their significance & applications | Class conduction using board and power point presentation. | Test and MCQ , assignments. |

**Paper I/Subject Name: PHARMACEUTICAL BIOTECHNOLOGY (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:**

Biotechnology has a long promise to revolutionize the biological sciences and technology. Scientific application of biotechnology in the field of genetic engineering, medicine and fermentation technologymakes the subject interesting. Biotechnology is leading to new biological revolutions in diagnosis, prevention and cure of diseases, new and cheaper pharmaceutical drugs. Biotechnology has already produced transgenic crops and animals and the future promises lot more. It is basically a research-based subject.

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

1. Understanding the importance of Immobilized enzymes in Pharmaceutical Industries
2. Genetic engineering applications in relation to production of pharmaceuticals
3. Importance of Monoclonal antibodies in Industries
4. Appreciate the use of microorganisms in fermentation technology

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | a) Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.<br>b) Enzyme Biotechnology- Methods of enzyme immobilization and applications.<br>c) Biosensors- Working and applications of biosensors in Pharmaceutical Industries.<br>d) Brief introduction to Protein Engineering.<br>e) Use of microbes in industry. Production of Enzymes- General consideration -<br>Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.<br>f) Basic principles of genetic engineering. | **10 hr** |
| **II.** | a) Study of cloning vectors, restriction endonucleases and DNA ligase.<br>b) Recombinant DNA technology. Application of genetic engineering in medicine.<br>c) Application of r DNA technology and genetic engineering in the production of:<br>i) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin.<br>d) Brief introduction to PCR | **10 hr** |
| **III.** | Types of immunity- humoral immunity, cellular immunity<br>a) Structure of Immunoglobulins<br>b) Structure and Function of MHC<br>c) Hypersensitivity reactions, Immune stimulation and Immune suppressions.<br>d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine,<br>antitoxins, serum-immune blood derivatives and other products relative to immunity.<br>e) Storage conditions and stability of official vaccines<br>f) Hybridoma technology- Production, Purification and Applications<br>g) Blood products and Plasma Substituties. | **10 Hr** |
| **IV** | a) Immuno blotting techniques- ELISA, Western blotting, Southern blotting.<br>b) Genetic organization of Eukaryotes and Prokaryotes | **15 hr** |

| | | |
|---|---|---|
| | c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.<br>d) Introduction to Microbial biotransformation and applications.<br>**e)** Mutation: Types of mutation/mutants.<br>f) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.<br>g) Large scale production fermenter design and its various controls.<br>h) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,<br>i) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substituties. | |
| **TOTAL** | | **45 hours** |

**Text Book:**


1. Glick B.R., Pasternak J.J. (2002) Molecular Biotechnology: Principles and Applications of RecombinantDNA, 3rd edition, ASM Press Washington D.C.
2. Goldshy R.A. (2002), Kuby Immunology, 5th edtion, WH Freeman & Co Ltd.
3. Goding J.W., Monoclonal Antibodies, 6th edition, W.H.Freeman & Co Ltd.
4. Walker J.M., Gingold E.B. (2015)Molecular Biology and Biotechnology by Royal Society of Chemistry, 6th edtion, RSC Publishing.


**Reference Books:**


1. Primrose S.B. (1991), Molecular Biotechnology, 2nd Edition, Blackwell Scientific Publication.
2. Stanbury F.P., Whitakar A., and Hall J.,(2016), Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi.


**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to understand the importance of Immobilized enzymes in Pharmaceutical Industries . | Traditional chalk and board teaching and presentations,hands-on- Microscopic study of epithelial and connective tissue, muscular and nervous tissue. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Students will be able to understand genetic engineering applications in relation to production of pharmaceuticals. | Traditional chalk and board teaching, power point presentations, laboratory based identification | MCQs, regular discussions Test on structure and functions of the organ system |
| III | Students will be able to understand Monoclonal antibodies in Industries . | Traditional teaching and regular discussions and power point presentation on blood and other body fluids | Test and MCQ , assignments. |

| | | | |
|---|---|---|---|
| IV | Students will be able to appreciate the use of microorganisms in fermentation technology | Class conduction using board and power point presentation. | Test and MCQ , assignments. |

**Paper I/Subject Name: PHARMACEUTICAL QUALITY ASSURANCE (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:**

This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It deals with the important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.

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

- Understand the cGMP aspects in a pharmaceutical industry
- Appreciate the importance of documentation
- Understand the scope of quality certifications applicable to pharmaceutical industries
- Understand the responsibilities of QA & QC departments

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Quality Assurance and Quality Management concepts:** Definition and concept of Quality control, Quality assurance and GMP<br>**Total Quality Management (TQM):** Definition, elements, philosophies<br>**ICH Guidelines**: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines<br>**Quality by design (QbD)**: Definition, overview, elements of QbD program, tools<br>**ISO 9000 & ISO14000**: Overview, Benefits, Elements, steps for registration<br>**NABL accreditation** : Principles and procedures | **10 hr** |
| **II.** | **Organization and personnel:** Personnel responsibilities, training, hygiene and personal records.<br>**Premises:** Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.<br>**Equipments and raw materials:** Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials. | **10 hr** |
| **III.** | **Quality Control:** Quality control test for containers, rubber closures and secondary packing materials.<br>**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 | **10Hr** |

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|---|---|---|
| **IV** | **Complaints:** Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.<br>**Document maintenance in pharmaceutical industry:** Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.<br>**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.<br>**Warehousing:** Good warehousing practice, materials managementd) | **15 hr** |
| **TOTAL** | | **45 hours** |

**Text Book:**

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Weinberg S. (2007), Good Laboratory Practice Regulations, 4th Edition, CRC Press.
3. WHO,(1997),Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I,WHO Publications.

**Reference Books:**

1. A.F. Hirsch (1995), Good laboratory Practices,2nd edition, Marcel Dekker Inc.
2. ICH guidelines, ISO 9000 and 14000 guidelines Teaching Learning Process and Assessment Methods.

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to understand the cGMP aspects in a pharmaceutical industry | Traditional chalk and board teaching and presentations,hands-on- Microscopic study of epithelial and connective tissue, muscular and nervous tissue. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Appreciate the importance of documentation | Traditional chalk and board teaching, power point presentations, laboratory based identification | MCQs, regular discussions Test on structure and functions of the organ system |
| III | Students will be able to understand the scope of quality certifications applicable to pharmaceutical industries<br>. | Traditional teaching and regular discussions and power point presentation on blood and other body fluids | Test and MCQ , assignments. |
| IV | Students will be able to understand the responsibilities of QA & QC departments. | Class conduction using board and power point presentation. | Test and MCQ , assignments. |

# B. Pharm VII Semester

**Paper I/Subject Name: Instrumentatal Methods of Analysis (Theory)**

**L-T-P-C – 3-1-2-6** **Credit Units: 6** **Scheme of Evaluation: (T/P/TP)**

**Objective:** This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

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

1. Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
2. Understand the chromatographic separation and analysis of drugs.
3. Perform quantitative & qualitative analysis of drugs using various analytical instruments.

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **UV Visible spectroscopy**<br>Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on<br>absorption spectra, Beer and Lambert's law, Derivation and deviations.<br>Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors-<br>Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode.<br>Applications - Spectrophotometric titrations, Single component and multi component<br>analysis<br>**Fluorimetry**<br>Theory, Concepts of singlet, doublet and triplet electronic states, internal and external<br>conversions, factors affecting fluorescence, quenching, instrumentation and applications | **10 hr** |
| **II.** | **IR spectroscopy**<br>Introduction, fundamental modes of vibrations in poly atomic molecules, sample<br>handling, factors affecting vibrations<br>Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell,<br>Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications<br>**Flame Photometry**-Principle, interferences, instrumentation and applications<br>**Atomic absorption spectroscopy**- Principle, interferences, instrumentation and<br>applications<br>**Nepheloturbidometry**- Principle, instrumentation and applications | **10 hr** |
| **III.** | **Introduction to chromatography**<br>**Adsorption and partition column chromatography**-Methodology, advantages,<br>disadvantages and applications.<br>**Thin layer chromatography**- Introduction, Principle, Methodology, Rf | **10 Hr** |

| | | |
|---|---|---|
| | values,<br>advantages, disadvantages and applications.<br>**Paper chromatography**-Introduction, methodology, development techniques,<br>advantages, disadvantages and applications<br>**Electrophoresis**– Introduction, factors affecting electrophoretic mobility, Techniques<br>of paper, gel, capillary electrophoresis, applications | |
| **IV** | **Gas chromatography -** Introduction, theory, instrumentation, derivatization,<br>temperature programming, advantages, disadvantages and applications<br>**High performance liquid chromatography (HPLC)-**Introduction, theory, instrumentation, advantages and applications.<br>**Ion exchange chromatography-** Introduction, classification, ion exchange resins,<br>properties, mechanism of ion exchange process, factors affecting ion exchange,<br>methodology and applications<br>**Gel chromatography-** Introduction, theory, instrumentation and applications<br>**Affinity chromatography-** Introduction, theory, instrumentation and applications | **15 hr** |
| **TOTAL** | | **45 hours** |

## INSTRUMENTAL METHODS OF ANALYSIS (Practical)

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | 1 Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds<br>2 Estimation of dextrose by colorimetry<br>3 Estimation of sulfanilamide by colorimetry | **4hr/wk** |
| **II.** | 4. Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy<br>5 Assay of paracetamol by UV- Spectrophotometry<br>6 Estimation of quinine sulfate by fluorimetry<br>7 Study of quenching of fluorescence | **4 hr/wk** |
| **III.** | 8. Determination of sodium by flame photometry<br>9 Determination of potassium by flame photometry<br>10 Determination of chlorides and sulphates by nephelo turbidometry<br>11 Separation of amino acids by paper chromatography | **4 hr/wk** |
| **IV** | 12. Separation of sugars by thin layer chromatography<br>13 Separation of plant pigments by column chromatography<br>14 Demonstration experiment on HPLC<br>15 Demonstration experiment on Gas Chromatography | **4 hr/wk** |
| **TOTAL** | | **60hours** |

**Text Book:**

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel

5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy byWilliam Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein
.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will able to explain the interaction of matter with electromagnetic radiations and its applications in drug analysis | Traditional chalk and board teaching, power point presentations on electromagnetic radiations | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Understand the chromatographic separation and analysis of drugs. | Traditional chalk and board teaching, power point presentations and laboratory chromatographic separation techniques. | MCQs, regular discussions Test on structure and functions of the organ system |
| III | Perform quantitative & qualitative analysis of drugs using various analytical instruments | Traditional teaching and regular discussions , power point presentation and laboratory instrumentation practice . | Test and MCQ , assignments. |

**Objective:** This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market.

**Course Outcome**: Upon completion of the course, the student shall be able to:
1. Know the process of pilot plant and scale up of pharmaceutical dosage forms
2. Understand the process of technology transfer from lab scale to commercial batch
3. Know different Laws and Acts that regulate pharmaceutical industry
4. Understand the approval process and regulatory requirements for drug products

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **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 | **10 hr** |
| **II.** | **Technology development and transfer:** WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and 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 | **10 hr** |
| **III.** | **Regulatory affairs:** Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals **Regulatory requirements for drug approval:** Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies. | **10 Hr** |
| **IV** | **Quality management systems:** Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP. **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. | **15 hr** |
| **TOTAL** | | **45 hours** |

**Text Book:**

**1.** Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition.

**References :**

1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April available at http,//en.wikipedia.org/wiki/Regulatory_ Affairs.
2. International Regulatory Affairs Updates, 2005. available at http://www.iraup.com/about.php
3. Regulatory Affairs brought by learning plus, inc. available at http.//www.cgmp.com/ra.htm.

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**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | The student shall be able to know the process of pilot plant and scale up of pharmaceutical dosage forms | Traditional chalk and board teaching, power point presentations | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Understand the process of technology transfer from lab scale to commercial batch | Traditional chalk and board teaching, power point presentations | MCQs, regular discussions Test |
| III | Know different Laws and Acts that regulate pharmaceutical industry | Traditional teaching and regular discussions , power point presentation on different Laws and Acts that regulate pharmaceutical industry | Test and MCQ , assignments. |
| IV | . Understand the approval process and regulatory requirements for drug products | Traditional teaching and regular discussions , power point presentation | Test and MCQ , assignments. |

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|---|---|---|
| **Paper 3/Subject Name:** | **PHARMACY PRATICE (Theory)** | |
| **L-T-P-C – 3-1-0-4** | **Credit Units: 4** | **Scheme of Evaluation: (T)** |

**Objective:** In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug information, and therapeutic drug monitoring for improved patient care. In community pharmacy, students will be learning various skills such as dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling for improved patient care in the community set up.

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

1. Know various drug distribution methods in a hospital
2. Appreciate the pharmacy stores management and inventory control
3. Monitor drug therapy of patient through medication chart review and clinical review
4. Obtain medication history interview and counsel the patients
5. Identify drug related problems
6. Detect and assess adverse drug reactions
7. Interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states
8. Know pharmaceutical care services
9. Do patient counseling in community pharmacy;
10. Appreciate the concept of Rational drug therapy.

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **a) Hospital and it's organization**<br>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.<br>**b) Hospital pharmacy and its organization**<br>Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.<br>**c) Adverse drug reaction**<br>Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management.<br>**d) Community Pharmacy**<br>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. | **10 hr** |

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| **II.** | **a) Drug distribution system in a hospital**<br>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.<br>**b) Hospital formulary**<br>Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital<br>formulary.<br>**c) Therapeutic drug monitoring**<br>Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic DrugMonitoring, and Indian scenario for Therapeutic Drug Monitoring.<br>**d) Medication adherence**<br>Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence.<br>**e) Patient medication history interview**<br>Need for the patient medication history interview, medication interview forms.<br>**f) Community pharmacy management**<br>Financial, materials, staff, and infrastructure requirements. | **10 hr** |
| **III.** | **a) Pharmacy and therapeutic committee**<br>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.<br>**b) Drug**<br>**information services**Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information.<br>**c) Patient counseling**<br>Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist<br>**d) Education and training program in the hospital**<br>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.<br>**e) Prescribed medication order and communication skills**<br>Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients. | **10 Hr** |

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| IV | **a) Budget preparation and implementation**<br>Budget preparation and implementation<br>**b) Clinical Pharmacy**<br>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.<br>**c) Over the counter (OTC) sales**<br>Introduction and sale of over the counter, and Rational use of common over the counter medications.<br>**a) Drug store management and inventory control**<br>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<br>**b) Investigational use of drugs**<br>Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.<br>**c) Interpretation of Clinical Laboratory Tests**<br>Blood chemistry, hematology, and urinalysis | **15 hr** |
| **TOTAL** | | **45 hours** |

**Text Book:**


1. Merchant S.H. and Dr. J.S.Quadry.( 2001) *A textbook of hospital pharmacy*, 4th ed. Ahmadabad: B.S. Shah Prakakshan.
2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata.( 2004) *A textbook of Clinical Pharmacy Practice- essential concepts and skills*, 1st ed. Chennai: Orient Longman Private Limited.
3. William E. Hassan.( 1986) *Hospital pharmacy*, 5th ed. Philadelphia: Lea & Febiger.
4. Tipnis Bajaj.( 2008) *Hospital Pharmacy*, 1st ed. Maharashtra: Career Publications.
5. Scott LT.( 2009) *Basic skills in interpreting laboratory data*, 4thed. American Society of Health System Pharmacists Inc.
6. Parmar N.S.( 2008) *Health Education and Community Pharmacy*, 18th ed. India: CBS Publishers & Distributers;.


**References:**


1. Therapeutic drug monitoring. ISSN: 0163-4356
2. Journal of pharmacy practice. ISSN : 0974-8326
3. American journal of health system pharmacy. ISSN: 1535-2900 (online)
4. Pharmacy times (Monthly magazine)


**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|

| | | | |
|---|---|---|---|
| I. | The student shall be able to know various drug distribution methods in a hospital<br>. | Traditional chalk and board teaching, power point presentations on drug distribution methods in a hospital | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | The students shall able to manage pharmacy stores and inventory control | Traditional chalk and board teaching, power point presentations and practice | MCQs, regular discussions Test on management of pharmacy stores and inventory control |
| III | Obtain medication history interview and counsel the patients, identify drug related problems, detect and assess adverse drug reactions, interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states | Traditional teaching and regular discussions , power point presentation | Test and MCQ , assignments. |
| IV | know pharmaceutical care services, do patient counseling in community pharmacy, appreciate the concept of Rational drug therapy. | Traditional teaching and regular discussions, power point presentation and practice on patient counseling | Test and MCQ , assignments. |

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| **Paper 4/Subject Name:** | **NOVEL DRUG DELIVERY SYSTEM (Theory)** | |
| **L-T-P-C – 3-1-0-4** | **Credit Units: 4** | **Scheme of Evaluation: (T)** |

**Objective:** This subject is designed to impart basic knowledge on the area of novel drug delivery systems.

**Course Outcome**: Upon completion of the course student shall be able
1. To understand various approaches for development of novel drug delivery systems.
2. To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **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<br>**Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery | **10 hr** |

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|---|---|---|
| | systems. | |
| **II.** | **Microencapsulation:** Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications<br>**Mucosal Drug Delivery system:** Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems<br>**Implantable Drug Delivery Systems:**Introduction, advantages and disadvantages, concept of implantsand osmotic pump | **10 hr** |
| **III.** | **Transdermal Drug Delivery Systems:** Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches<br>**Gastroretentive drug delivery systems:** Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications<br>**Nasopulmonary drug delivery system:** Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers | **10 Hr** |
| **IV** | **Targeted drug Delivery:** Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications<br>**Ocular Drug Delivery Systems:** Introduction, intra ocular barriers and methods to overcome –Preliminary study, ocular formulations and ocuserts<br>**Intrauterine Drug Delivery Systems:** Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications | **8 hr** |
| **TOTAL** | | **45 hours** |

**Text Book:**


1. Y W. Chien,( 1992) Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York.
2. Robinson, J. R., Lee V. H. L,( 1992) Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York.
3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim
4. N.K. Jain,( (reprint in 2001).) Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997.
5. S.P. Vyas and R.K. Khar, (2002) Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition.


**References :**


1. Indian Journal of Pharmaceutical Sciences (IPA)
2. Indian Drugs (IDMA)
3. Journal of Controlled Release (Elsevier Sciences)
4. Drug Development and Industrial Pharmacy (Marcel & Decker)

5. International Journal of Pharmaceutics (Elsevier Sciences)

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students are able to understand various approaches for development of novel drug delivery systems. | Traditional chalk and board teaching, power point presentations on development of novel drug delivery systems. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Students will understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation . | Traditional chalk and board teaching, power point presentations on Novel drug delivery systems | MCQs, regular discussions Test on Novel drug delivery systems |

# B. Pharm VIII Semester

**Paper I/Subject Name: BIOSTATISITCS AND RESEARCH METHODOLOGY (THEORY)**

**L-T-P-C – 3-1-0-4** **Credit Units: 4** **Scheme of Evaluation: (T/P/TP)**

**Objective:** To understand the applications of Biostatics in Pharmacy. This subject deals with descriptive statistics, Graphics, Correlation, Regression, logistic regression Probability theory, Sampling technique, Parametric tests, Non Parametric tests, ANOVA, Introduction to Design of Experiments, Phases of Clinical trials and Observational and Experimental studies, SPSS, R and MINITAB statistical software's, analyzing the statistical data using Excel.

**Course Outcome**: Upon completion of this course the student should be able to
Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment) • Know the various statistical techniques to solve statistical problems • Appreciate statistical techniques in solving the problems.

**Detailed Syllabus**

| Modules | Topics (if applicable) & Course Contents | Periods |
|---|---|---|
| **I.** | **Introduction**: Statistics, Biostatistics, Frequency distribution<br>**Measures of central tendency**: Mean, Median, Mode- Pharmaceutical examples<br>**Measures of dispersion:** Dispersion, Range, standard deviation, Pharmaceutical problems<br>**Correlation**: Definition, Karl Pearson's coefficient of correlation, Multiple correlation Pharmaceuticals examples | **10 hr** |
| **II.** | **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<br>**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<br>**Parametric test:** t-test(Sample, Pooled or Unpaired and Paired) , ANOVA, (One way and Two way), Least Significance difference | **10 hr** |
| **III.** | **Non Parametric tests**: Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test<br>156<br>**Introduction to Research**: Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism<br>**Graphs:** Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot | **10 hr** |

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| | graph<br>**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 | |
| **IV** | Blocking and confounding system for Two-level factorials<br>**Regression modeling**: Hypothesis testing in Simple and Multiple regression models<br>**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<br>**Design and Analysis of experiments:** Factorial Design: Definition, 22, 23design. Advantage of factorial design Response<br>**Surface methodology:** Central composite design, Historical design, Optimization Technique | **15 hr** |
| **TOTAL** | | **45 hours** |

**Recommended Books (Latest edition):**


1. Sanford, B. (1990). Pharmaceutical statistics- Practical and clinical applications, 80(6), NewYork: Marcel Dekker Inc. publisher.
2. Guptha S.C. (2018). Fundamental of Statistics, 7th edition, Himalaya Publishing House.
3. Pannerselvam, R (2012). Design and Analysis of Experiments, New Delhi: PHI Learning Private Limited.
4. Montgomery and Douglas C. (2013). Design and Analysis of Experiments, 8th edition, New Jersey: Wiley Students.


**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| I. | Students will be able to explain the basics of statistics and biostatistics, measures of central tendency and dispersion and correlation. | Traditional chalk and board teaching and power point presentations. | Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session. |
| II. | Students will learn about various statistical data analysis methods like regression, probability,parametric tests | Traditional chalk and board teaching, power point presentations, statistical charts. | MCQs, regular discussions, internal class Tests, assignments. |
| III | Students will be able to learn about non parametric tests, graphs and research methodologies, | Traditional teaching and regular discussions and power point presentation | Test and MCQ , assignments. |

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|---|---|---|---|
| IV | Students will be able to learn about two level factorials, Regression modelling, Practical components of Industrial and Clinical Trials Problems etc. | Class conduction using board and power point presentation. | Test and MCQ , assignments. |

| **Paper II/ Subject Name: SOCIAL AND PREVENTIVE PHARMACY** | | |
|---|---|---|
| **L-T-P-C – 3-1-0-4** | **Credit Units: 4** | **Scheme of Evaluation: (T/P/TP)** |

**Objective**: The purpose of this course is to introduce to students a number of health issues and their challenges. This course also introduced a number of national health programmers. The roles of the pharmacist in these contexts are also discussed.

**Course outcome:** After the successful completion of this course, the student shall be able to:

1. Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.

2. Have a critical way of thinking based on current healthcare development.

3. Evaluate alternative ways of solving problems related to health and pharmaceutical issues

**Detailed syllabus**

| **Module** | **Topics (if applicable)/course content** | **Hours** |
|---|---|---|
| I | **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.<br><br>**Social and health education:** Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention<br><br>**Sociology and health**: Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health<br><br>**Hygiene and health**: personal hygiene and health care; avoidable habits | 10 hours |
| II | **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 | 10hours |

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|---|---|---|
| | substance abuse | |
| III | **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 158 programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme. | 10hours |
| Iv | 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<br><br>**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 | 15 hours |
| | **Total** | **45** |

**Recommended books (Latest edition):**


1. Prabhakara G.N (2010). Short Textbook of Preventive and Social Medicine, 2nd edition, New Delhi: Jaypee Publications.

2. Rabindra N, Indranil S. (2013). Textbook of Preventive and Social Medicine (Mahajan and Gupta), 4th edition, New Delhi: Jaypee Publications.

3. Jain V, (2014). Review of Preventive and Social Medicine (Including Biostatistics), 6th edition, New Delhi: Jaypee Publications.

4. Hiremath L.D., (2012). Essentials of Community Medicine—A Practical Approach, 2nd edition, Jaypee Publications .

5. Park K. (2011). Textbook of Preventive and Social Medicine, 21st Edition, Banarsidas bhanot publishers.

6. Adepu R. (2015). Community Pharmacy Practice, Hyderabad : BSP publishers,.


**Recommended Journals:**


1. Desselle S etal (2021), Research in Social and Administrative Pharmacy, Ireland: Elsevier, 17(3) 487–642


**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **I** | The students will be able to understand the concept of health and disease, social and health education etc. | Traditional teaching, PPT | Assignment, class tests, MCQ |
| **II** | The students will be able to explain about preventive medicines | Traditional teaching, PPT | Assignment, class tests, MCQ |
| **III** | The students will be able to understand about various National health programs, its objectives and functioning | Traditional teaching, PPT | Assignment, class tests, MCQ |
| **IV** | The students will be able to understand about various National health programs, its objectives and functioning | Traditional teaching, PPT | Assignment, class tests, MCQ |

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|---|---|---|
| **Paper III/Subject name:** | **PHARMA MARKETING MANAGEMENT (Theory)** | |
| **L-T-P-C – 3-1-0-4** | **Credit Units: 4** | **Scheme of Evaluation: (T/P/TP)** |

**Objective:** The pharmaceutical industry not only needs highly qualified researchers, chemists and, technical people, but also requires skilled managers who can take the industry forward by managing and taking the complex decisions which are imperative for the growth of the industry. The Knowledge and Know-how of marketing management groom the people for taking a challenging role in Sales and Product management.

**Course Outcome:** The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry**.**

| Module | Topics (if applicable)/course content | Hours |
|---|---|---|
| **I** | **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.<br><br>**Pharmaceutical market:** Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation& | 10hr |

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|---|---|---|
| | targeting.Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist.Analyzing the Market;Role of market research | |
| **II** | **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<br><br>**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 | 10hr |
| **III** | **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.<br><br>**Emerging concepts in marketing:** Vertical & Horizontal Marketing; RuralMarketing; Consumerism; Industrial Marketing; Global Marketing. | 10hr |
| **IV** | **Pharmaceutical marketing channels:** Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.<br><br>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. | 15 Hr |
| | **Total** | **45** |

**Recommended Books: (Latest Editions)**


1. Philip K and Kevin L. (2019). Marketing Management, 17th edition, New Delhi: Prentice Hall of India.

2. Walker, Boyd and Larreche. (1999). Marketing Strategy- Planning and Implementation. New Delhi:

Tata MC Graw Hill.

3. Grewal D and Levy M. (2020). Marketing. 7th edition, New Tata MC Graw Hill.

4. Kumar A and Menakshi N. ((2011). Marketing Management, 2nd edition, New Delhi: Vikas Publishing.

5. Saxena R (2019). Marketing Management.6th edition. Tata MC Graw-Hill (India Edition).

6. Ramaswamy, U.S & Nanakamari, S (2018). Marketing Management: Global Perspective, Indian Context, 4th edition, New Delhi: Sage publishing.

7. Shanker, Ravi (2002). Service Marketing, New Delhi: Excel Books.

8. Rao S.C. (2018). Pharmaceutical Marketing in India (GIFT – Excel series): 25th edition, Excel Publications.

**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | The students will get to learn about pharmaceutical marketing | Traditional teaching, PPT | Assignment, class tests, MCQ |
| **II** | The students will get to learn about product decision. | Traditional teaching, PPT | Assignment, class tests, MCQ |
| **III** | The students will get to learn about the emerging concept of marketing | Traditional teaching, PPT | Assignment, class tests, MCQ |
| **IV** | The students will get to learn about pharmaceutical marketing channels | Traditional teaching, PPT | Assignment, class tests, MCQ |

| | | |
|---|---|---|
| **Paper IV /Subject paper:** | **PHARMACEUTICAL REGULATORY SCIENCE (Theory)** | |
| **L-T-P-C – 3-1-0-4** | **Credit Units: 4** | **Scheme of Evaluation: (T/P/TP)** |

**Objective :** This course is designed to impart the fundamental knowledge on the regulatory requirements for approval of new drugs, and drug products in regulated markets of India & other countries like US, EU, Japan, Australia,UK etc. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products**.**

**Course outcome:** Upon completion of the subject student shall be able to;

1. Know about the process of drug discovery and development

2. Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals

3. Know the regulatory approval process and their registration in Indian and international markets

**Detailed syllabus**:

| **Module** | **Topics (if applicable)/course content** | **Hours** |
|---|---|---|
| I | **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.<br><br>**Social and health education:** Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention<br><br>**Sociology and health**: Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health<br><br>**Hygiene and health**: personal hygiene and health care; avoidable habits | 10 |
| II | **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, | 10 |

| | | |
|---|---|---|
| | drug addiction-drug substance abuse | |
| III | **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 158 programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme. | 10 |
| IV | 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<br><br>**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 | 15 |
| | Total | 45 |

**Recommended books (Latest edition):**


1. Itkar S, Dr. Vyawahare N.S. (2019) Drug Regulatory Affairs, 4th edition, New Delhi: Nirali Prakashan.

2. Berry I.R. and Martin R.P. (2019). The Pharmaceutical Regulatory Process, 2nd edition. Informa Health care Publishers.

3. Richard A.G., M.D. (2004). New Drug Approval Process: Accelerating Global Registrations, 5th edition, CRC press.

4. Weinberg S. (2009). Guidebook for drug regulatory submissions, 1st edition, John Wiley & Sons. Inc. publishers.

5. Douglas J. P., David M (2008). FDA Regulatory Affairs: a guide for prescription drugs medical devices, and biologics, 2nd edition: CRC Press.

6. Leon S. and Isader K. (2005). Generic Drug Product Development, Solid Oral Dosage forms, New York: Marcel Dekker series.

7. Fay A.R. and Rodney K.A. (2003). Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance, 1st edition., San Francisco: Jossey-Bass.

8. John I. G. and Frederick P. O., (2011). Principles and Practices of Clinical Research, 2nd edition, Academic Press.

9. Rick N. (2015). Drugs: From Discovery to Approval, 2nd Edition, Wiley-Blackwell.


**Teaching Learning Process and Assessment Methods**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | The students will get to learn about New Drug Discovery and development | Traditional teaching, PPT | Class tests, assignments, mcq |
| **II** | The students will get to learn to explain Regulatory Approval Process | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **III** | The students will get to learn about the registration of Indian drug product in overseas market | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **IV** | The students will get to learn about clinical trials and regulatory concepts. | Traditional teaching, PPT | Class tests, assignemts, mcq |

**Paper V /Subject paper: PHARMACOVIGILANCE(THEORY)**

**L-T-P-C – 3-1-0-4 Credit Units: 4 Scheme of Evaluation: (T/P/TP)**

**Objective**: This paper will provide an opportunity for the student to learn about development of pharmacovigilance as a science, basic terminologies used in pharmacovigilance, global scenario of Pharmacovigilance, train students on establishing pharmacovigilance programmed in an organization, various methods that can be used to generate safety data and signal detection. This paper also develops the skills of classifying drugs, diseases and adverse drug reactions.

**Course outcome:** On completion of this paper, it is expected that students will be able to (know, do, and appreciate):

1. Why drug safety monitoring is important?
2. History and development of pharmacovigilance
3. National and international scenario of pharmacovigilance
4. Dictionaries, coding and terminologies used in pharmacovigilance
5. Detection of new adverse drug reactions and their assessment
6. International standards for classification of diseases and drugs

7. Adverse drug reaction reporting systems and communication in pharmacovigilance

8. Methods to generate safety data during pre-clinical, clinical and post approval phases of drugs' life cycle

9. Drug safety evaluation in paediatrics, geriatrics, pregnancy and lactation

10. Pharmacovigilance Program of India (PvPI) requirement for ADR reporting in India

11. ICH guidelines for ICSR, PSUR, expedited reporting, pharmacovigilance planning

12. CIOMS requirements for ADR reporting

13. Writing case narratives of adverse events and their quality.

| **Module** | **Topics (if applicable)/course content** | **Hours** |
|---|---|---|
| I | **History and development of Pharmacovigilance** :Importance of safety monitoring of Medicine ,<br><br>WHO international drug monitoring programme , Pharmacovigilance Program of India(PvPI)<br><br>**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<br><br>**Basic terminologies used in pharmacovigilance**<br><br>Terminologies of adverse medication related events, Regulatory terminologies | 10 |
| II | **Drug and disease classification:**<br><br>Anatomical, therapeutic and chemical classification of drugs, International classification of diseases, Daily defined doses, International Nonproprietary Names for drugs.<br><br>**Drug dictionaries and coding in pharmacovigilance:** WHO adverse reaction terminologies  MedDRA and Standardised MedDRA queries, WHO drug dictionary, Eudravigilance medicinal product dictionary<br><br>**Information resources in pharmacovigilance:** Basic drug information resources ,Specialised resources for ADRs<br><br>**Establishing pharmacovigilance programme :** Establishing in a hospital ,Establishment & operation of drug safety department in industry , Contract Research Organisations (CROs), Establishing a national programme | 10 |
| III | **Vaccine safety surveillance:** Vaccine Pharmacovigilance,Vaccination failure , Adverse events following immunization | 10 |

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|---|---|---|
| | **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<br><br>**Communication in pharmacovigilance**: Effective communication in Pharmacovigilance, Communication in Drug Safety Crisis management, Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media | |
| IV | **Safety data generation: Pre**clinical phase, Clinical phase  Post approval phase (PMS)<br><br>**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.<br><br>**Pharmacogenomics of adverse drug reactions** Genetics related ADR with example focusing PK parameters.<br><br>**Drug safety evaluation in special population**: Paediatrics , Pregnancy and lactation , Geriatrics<br><br>**CIOMS**: CIOMS Working Groups, CIOMS Form<br><br>**CDSCO (India) and Pharmacovigilance :**D&C Act and Schedule Y, Differences in Indian and global pharmacovigilance requirements | 15 |
| | Total | 45 |

**Recommended Books (Latest edition):**


1 Gupta S. K. (2011). Textbook of Pharmacovigilance, 1st edition, New Delhi: Jaypee Brothers Medical Publishers.

2. Barton C., Andrews E.B. (2014). Mann's Pharmacovigilance, 3rd edition: Wiley-Blackwell Publishers.

4. John T., Patrick W. (2004). Stephens' Detection of New Adverse Drug Reactions, 5th edition: John Wiley & Sons Ltd.

5. Patrick W. (2011). An Introduction to Pharmacovigilance, 1st edition: Wiley-Blackwell publisher.

6. Barton C (2011). Colbert's Manual of Drug Safety and Pharmacovigilance, revised edition: Jones& Bartlett Publishers.

7. Brian L. S., Stephen E.K., Sean H. (2013). Textbook of Pharmacoepidemiology, 2nd edition: Wiley Publishers.

**Textbooks**

1. National Formulary of India

2. Yashpal M (**2019**). Textbook of Medicine, 11th edition, CBS Publishers & Distributors.

3. Mohanta G.P. and Mann P.K. (2015). Textbook of Pharmacovigilance: concept and practice. Pharma Med Press/ BSP Books.

**Teaching Learning Process and Assessment Methods:**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | The students will be able to learn about Pharmacovigilance, adverse drug reactions, | Traditional teaching, PPT | Class tests, assignments, mcq |
| **II** | The students will be able to learn about various drug and disease classification, Drug dictionaries and coding in pharmacovigilanc, Information resources in pharmacovigilanc etc. | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **III** | The students will be able to explain about Vaccine safety surveillance, Pharmacovigilance method, Communication in pharmacovigilance | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **IV** | The students will be able to learn about various ICH Guidelines for Pharmacovigilance, CDSCO (India) and Pharmacovigilanc, CIOMS | Traditional teaching, PPT | Class tests, assignemts, mcq |

**Paper VI / Subject name: QUALITY CONTROL AND STANDARDIZATION OF HERBALS (Theory)**

**L-T-P-C – 3-1-0-4** **Credit Units:4** **Scheme of Evaluation: (T/P/TP)**

**Objective:** In this subject the student learns about the various methods and guidelines for evaluation and standardization of herbs and herbal drugs. The subject also provides an opportunity for the student to learn cGMP, GAP and GLP in traditional system of medicines.

**Course outcome**: At completion of this paper, it is expected that students will be able to (know, do, and appreciate):

1. know WHO guidelines for quality control of herbal drugs.

2. know Quality assurance in herbal drug industry.

3. know the regulatory approval process and their registration in Indian and international markets.

4. appreciate EU and ICH guidelines for quality control of herbal drugs.

| **Module** | **Topics (if applicable)/course content** | **Hours** |
|---|---|---|
| I | Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms WHO guidelines for quality control of herbal drugs.<br>Evaluation of commercial crude drugs intended for use | 10 hours |
| II | Quality assurance in herbal drug industry of cGMP, GAP, GMP and GLP in traditional system of medicine.<br>WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants | 10 hours |
| III | EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines | 10 hours |

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|---|---|---|
| IV | Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products.<br><br>Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions.<br><br>Regulatory requirements for herbal medicines.<br><br>WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems Comparison of various Herbal Pharmacopoeias.<br><br>Role of chemical and biological markers in standardization of herbal products | 15 hours |
| | **Total** | **45 hours** |

**Recommended Books:**


1.William, E. C. (2009). Trease and Evans' pharmacognosy,16th edition, Elsivier

2.Kokate C.K., Purohit A.P., Gokhale S.B. (2007). Pharmacognosy, 40th edition, Nirali Prakashan.

3.Rangari, V.D. (2009). Textbook of Pharmacognosy and Phytochemistry vol. II, 2nd edition, Carrier Publication.

4. Aggrawal S. S. (2002). Herbal Drug Technology, 2nd edition, Universities Press.

5. Mukherjee P.W. (2012). Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals, 1st Unit, New Delhi: Business Horizons Publishers.

7. Shinde M.V., Dhalwal K., Potdar K., Mahadik K (2009). Application of quality control principles to herbal drug: International Journal of Phytomedicine, 1: 4 - 8

8. WHO. (1998). Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva. WHO Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila.

9. WHO. (1981). The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edition. World Health Organization, Geneva.

10. WHO. (1999) Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva,

11. WHO.(2005). WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva

12. WHO, (2004). Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. Geneva: World Health Organization

**Teaching Learning Process and Assessment Methods:**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | The students will be able to learn about various WHO guidelines for quality control of herbal drugs | Traditional teaching, PPT | Class tests, assignments, mcq |
| **II** | The students will be able to learn aboutknow Quality assurance in herbal drug industry. | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **III** | The students will be able to explain about the regulatory approval process and their registration in Indian and international markets | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **IV** | The students will be able to learn to appreciate EU and ICH guidelines for quality control of herbal drugs | Traditional teaching, PPT | Class tests, assignemts, mcq |

| Paper VII Subject name: **COMPUTER AIDED DRUG DESIGN (Theory)** | | |
|---|---|---|
| **L-T-P-C – 3-1-0-4** | **Credit Units:4** | **Scheme of Evaluation: (T/P/TP)** |

**Objective**: This subject is designed to provide detailed knowledge of rational drug design process and various techniques used in rational drug design process.

**Course outcome:** Upon completion of the course, the student shall be able to understand.

1. Design and discovery of lead molecules
2. The role of drug design in drug discovery process
3. The concept of QSAR and docking.
4. Various strategies to develop new drug like molecules.
5. The design of new drug molecules using molecular modelling software.

**Detailed syllabus**

| Module | Topics (if applicable)/course content | Hours |
|---|---|---|
| I | **Introduction to Drug Discovery and Development:**<br>Stages of drug discovery and development<br><br>**Lead discovery and Analog Based Drug Design**<br>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.<br><br>**Analog Based Drug Design:**<br>Bioisosterism, Classification, Bioisosteric replacement. Any three case studies | 10 hours |
| II | **Quantitative Structure Activity Relationship (QSAR)** :<br>SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and | 10 hours |

| | | |
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| | COMSIA | |
| III | **Molecular Modeling and virtual screening techniques**<br><br>**Virtual Screening techniques:** Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening.<br><br>**Molecular docking:** Rigid docking, flexible docking, manual docking, Docking based screening. De novo drug | 10 hours |
| IV | **Informatics & Methods in drug design**:<br><br>Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.<br><br>**Molecular Modeling:** Introduction to molecular mechanics and quantum mechanics. Energy Minimization methods and Conformational Analysis, global conformational minima determination. | 15 hours |
| | **Total** | **45 hours** |

**Recommended Books (Latest Editions**)


1. Robert GCK, (1977). Drug Action at the Molecular Level, 1st edition, Baltimore: University Prak Press

2. Martin YC. (2010). Quantitative Drug Design. 2nd edition, , New York: CRC Press Dekker.

3. Delgado J.N., Remers W.A. (1999). Wilson & Gisvolds's Textbook of Organic Medicinal & Pharmaceutical Chemistry, Journal of Medicinal Chemistry **,**42 (13), 2491-2491

4. Foye W.O. (1989). Principles of Medicinal chemistry, 3rd edition, U.S: Lea & Febiger.

5. Koro l. A, Burckhalter J.H. (1977). Essentials of Medicinal Chemistry, Wiley Interscience. ,66(6): 910-910.

6. Wolf ME (1980). The Basis of Medicinal Chemistry.Burger's Medicinal Chemistry, 4th Edition, New York: John Wiley & Sons.

7. Patrick Graham, L. (2017). An Introduction to Medicinal Chemistry, 6th edition, Oxford University Press.

8. Smith H.J., Williams H (2005). Introduction to the principles of Drug Design.4th edition: CRC Press.

9. Silverman R.B. (2014). The organic Chemistry of Drug Design and Drug Action, 3rd edition, New York: Academic Press.

**Teaching Learning Process and Assessment Methods:**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | The students will be able to learn about Design and discovery of lead molecules | Traditional teaching, PPT | Class tests, assignments, mcq |
| **II** | The students will be able to learn about the role of drug design in drug discovery process. | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **III** | The students will be able to explain about The concept of QSAR and docking | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **IV** | The students will be able to learn Various strategies to develop new drug like molecules. and The design of new drug molecules using molecular modeling software | Traditional teaching, PPT | Class tests, assignemts, mcq |

**Paper VIII: subject Name: CELL AND MOLECULAR BIOLOGY (Elective subject)**

**L-T-P-C – 3-1-0-4** **Credit Units:4** **Scheme of Evaluation: (T/P/TP)**

**Objective:** Cell biology is a branch of biology that studies cells – their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function.

- This is done both on a microscopic and molecular level.
- Cell biology research encompasses both the great diversity of single-celled organisms like bacteria and protozoa, as well as the many specialized cells in multi-cellular organisms such as humans, plants, and sponges.

**Course outcome:** Upon completion of the subject student shall be able to;

- Summarize cell and molecular biology history.
- Summarize cellular functioning and composition.
- Describe the chemical foundations of cell biology.
- Summarize the DNA properties of cell biology.
- Describe protein structure and function.
- Describe cellular membrane structure and function.
- Describe basic molecular genetic mechanisms.
- Summarize the Cell Cycle

**Detailed syllabus**

| Module | Topics (if applicable)/course content | Hours |
|---|---|---|
| I | a) Cell and Molecular Biology: Definitions theory and basics and Applications.<br>b) Cell and Molecular Biology: History and Summation.<br>c) Properties of cells and cell membrane.<br>d) Prokaryotic versus Eukaryotic | 10hours |

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|---|---|---|
| | e) Cellular Reproduction<br>f) Chemical Foundations – an Introduction and Reactions (Types) | |
| II | a) DNA and the Flow of Molecular Information<br>b) DNA Functioning<br>c) DNA and RNA d<br>d) Types of RNA<br>e) Transcription and Translation | 10 hours |
| III | a) Proteins: Defined and Amino Acids<br>b) Protein Structure<br>c) Regularities in Protein Pathways<br>d) Cellular Processes<br>e) Positive Control and significance of Protein Synthesis | 10 hours |
| IV | a) Science of Genetics<br>b) Transgenics and Genomic Analysis<br>c) Cell Cycle analysis<br>d) Mitosis and Meiosis<br>e) Cellular Activities and Checkpoints<br>f) Cell Signals: Introduction<br>g) Receptors for Cell Signals<br>h) Signaling Pathways: Overview<br>i) Misregulation of Signaling Pathways<br>j) Protein-Kinases: Functioning | 15 hours |
| Total | | 45 hours |

**Recommended Books (latest edition):**

1. Hugo W.B. and Russel A.D. (2004), Pharmaceutical Microbiology, 7th edition, Oxford London: Blackwell Scientific publications.

2. Prescott and Dunn (2004). Industrial Microbiology,4th edition, Delhi: CBS Publishers & Distributors.

3. Pelczar, Chan K. (1993) Microbiology, 5th edition, Tata McGraw Hill.

4. Harris M, Balliere (1965). Tindall and Cox: Pharmaceutical Microbiology, Journal of pharmaceutical sciences. The Williams & Wilkins Co., Baltimore 2, 66(1*).*

5. Rose A.H. (1963). Industrial Microbiology: journal of basic microbiology. 3(3): 230.

6. Frobisher M. Hinsdill et al (1974). Fundamentals of Microbiology,9th edition, Japan: Thomson Learning.

7. Carter S.J. (2008). Cooper and Gunn's: Tutorial Pharmacy, 12th edition, CBS Publisher and Distribution.

8. Peppler H.J. (2014). Microbial Technology, 2nd edition, Academic Press.

9. Edward (1983). Fundamentals of Microbiology. Addison-Wesley Educational Publishers Inc.

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**Teaching Learning Process and Assessment Methods**:

| **Unit No.** | **Course Learning Outcomes** | **Teachingand Learning Activity** | **Assessment Tasks** |
|---|---|---|---|
| **I** | The students will be able to learn about Summarize cell and molecular biology history. And Summarize cellular functioning and composition | Traditional teaching, PPT | Class tests, assignments, mcq |
| **II** | The students will be able to learn about Describe protein structure and function | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **III** | The students will be able to learn about Describe cellular membrane structure and function | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **IV** | The students will be able to learn about Describe basic molecular genetic mechanisms. Summarize the Cell Cycle | Traditional teaching, PPT | Class tests, assignemts, mcq |

| Paper IX/subject Name : | COSMETIC SCIENCE(Theory) | |
|---|---|---|
| **L-T-P-C – 3-1-0-4** | **Credit Units:4** | **Scheme of Evaluation: (T/P/TP)** |

**Objective:**This subject is designed to provide detailed knowledge of cosmetics and various cosmeceutical products ,different cosmetic excipients and their applications in hair , face ,skin etc.

| Module | Topics (if applicable)/course content | Hours |
|---|---|---|
| I | **Classification of cosmetic and cosmeceutical products** Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs<br><br>**Cosmetic excipients:** Surfactants, rheology modifiers, humectants, emollients, preservatives. Classification and application<br><br>**Skin**: Basic structure and function of skin.<br><br>**Hair:** Basic structure of hair. Hair growth cycle.<br><br>**Oral Cavity:** Common problem associated with teeth and gums | 10 hours |
| II | **Principles of formulation and building blocks of skin care products:** Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages.<br><br>Application of these products in formulation of cosmecuticals. **Antiperspants & deodorants-** Actives & mechanism of action. **Principles of formulation and building blocks of Hair care products:** Conditioning shampoo, Hair conditioner,anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phylene di amine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash. | 10 hours |
| III | Sun protection, Classification of Sunscreens and SPF.<br><br>**Role of herbs in cosmetics:** Skin Care: Aloe and turmeric Hair care: Henna and amla. Oral care: Neem and clove<br><br>**Analytical cosmetics:** BIS specification and analytical methods for shampoo, skin- cream and toothpaste | 10 hours |
| IV | **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 benfits. Oily and dry skin causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis. Cosmetic problems associated with Hair | 15 hours |

| | | |
|---|---|---|
| | 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. | |

**References:**

1) Wilkinson, Moore J.B. (1982). Harry's Cosmeticology, 7th Edition. George Godwin.,

2) Sharma P.P. (2014). Cosmetics – Formulations, Manufacturing and Quality Control: 5th Edition, Delhi:

Vandana Publications Pvt. Ltd.

**Teaching Learning Process and Assessment Methods:**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | The students will be able to learn about cosmetic and cosmeceutical products. | Traditional teaching, PPT | Class tests, assignments, mcq |
| **II** | The students will be able to learn Principles of formulation and building blocks of skin care products and hair care products | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **III** | The students will be able to learn about Role of herbs in cosmetics | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **IV** | The students will be able to learn about Principles of Cosmetic Evaluation | Traditional teaching, PPT | Class tests, assignemts, mcq |

| **Paper X/ Subject name :** PHARMACOLOGICAL SCREENING METHODS | | |
|---|---|---|
| **L-T-P-C – 3-1-0-4 (T/P/TP)** | **Credit Units:4** | **Scheme of Evaluation:** |

**Objective:** This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.

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

1.Appreciate the applications of various commonly used laboratory animals.

2.Appreciate and demonstrate the various screening methods used in preclinical research.

3.Appreciate and demonstrate the importance of biostatistics and research methodology.

4. Design and execute a research hypothesis independently.

| Module | Topics (if applicable)/course content | Hours |
|---|---|---|
| **I** | **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 | **10 hours** |
| **II** | **Preclinical screening models**<br><br>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.<br><br>b. Study of screening animal models for Diuretics, nootropics, anti-Parkinson's,antiasthmatics,<br><br>**Preclinical screening models:** for CNS activity- analgesic, antipyretic,anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease | **10 hours** |
| **III** | Preclinical screening models: for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics | |
| **IV** | **Preclinical screening models:** for CVS activity-antihypertensives, diuretics, antiarrhythmic, antidyslepidemic, anti- | |

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| | aggregatory, coagulants, and anticoagulants Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.<br><br>**Research methodology and Bio-statistics** Selection of research topic, review of literature, research hypothesis and study design Pre-clinical data analysis and interpretation using Student's 't' test and One-way ANOVA. Graphical representation of data. | |
| **Total** | | **45 hours** |

**Recommended Books (latest edition):**


1. Ghosh M.N. (2008). Fundamentals of experimental Pharmacology-6th edition. Hilton and Company.

2. Kulakarni S.K. (2005). Handbook of Experimental Pharmacology, 3rd edition, Delhi: Vallabh Prakashan,

3. CPCSEA guidelines for laboratory animal facility.

4. Vogel H.G. (2008). Drug discovery and Evaluation, 2nd edition, Springer-Verlag Berlin Heidelberg.

5.Gupta S.K. (2016). Drug Screening Methods, 3rd edition, Jaypee Brothers Medical Publishers.

6. Rao PSS and Richard J (2012). Introduction to biostatistics and research methods, 5th edition

PHI learning.


**Teaching Learning Process and Assessment Methods:**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | The students will be able to learn about the applications of various commonly used laboratory animals. | Traditional teaching, PPT | Class tests, assignments, mcq |
| **II** | The students will be able to learn Appreciate and demonstrate the various screening methods used in preclinical research. | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **III** | The students will be able to learn to demonstrate the importance of | Traditional teaching, | Class tests, assignemts, |

| | | | |
|---|---|---|---|
| | biostatistics and research methodology. | PPT | mcq |
| **IV** | The students will be able to learn about Design and execute a research hypothesis independently | Traditional teaching, PPT | Class tests, assignemts, mcq |

| **Paper XI/ Subject Paper: ADVANCED INSTRUMENTATION TECHNIQUES** | | |
|---|---|---|
| **L-T-P-C – 3-1-0-4 (T/P/TP)** | **Credit Units:4** | **Scheme of Evaluation:** |

**Objective:** This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart advanced knowledge on the principles and instrumentation of spectroscopic and chromatographic hyphenated techniques. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

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

- understand the advanced instruments used and its applications in drug analysis
- understand the chromatographic separation and analysis of drugs.
- understand the calibration of various analytical instruments
- know analysis of drugs using various analytical instruments.

| **Module** | **Topics (if applicable)/course content** | **Hours** |
|---|---|---|
| **I** | **Nuclear Magnetic Resonance spectroscopy**<br><br>Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications<br><br>**Mass Spectrometry-** Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers- Time of flight and Quadrupole, instrumentation, applications. | **10 hours** |
| **II** | **Thermal Methods of Analysis:** Principles, instrumentation and applications of ThermogravimetricAnalysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC)<br><br>**X-Ray Diffraction Methods**: Origin of X-rays, basic aspects of | **10 hours** |

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|---|---|---|
| | crystals, Xray Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications. | |
| **III** | **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 | **10 hours** |
| **IV** | **Radio immune assay**: Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay<br><br>**Extraction techniques**: General principle and procedure involved in the solid phase extraction and liquid-liquid extraction<br><br>**Hyphenated techniques**-LC-MS/MS, GC-MS/MS, HPTLC-MS. | **15 hours** |
| | **Total** | **45 hours** |

**Recommended Books (Latest Editions)**


1. Sharma B.K. (2005). Instrumental Methods of Chemical Analysis, 24th edition, Uttar Pradesh: Krishna Prakashan Media.

2. Sharma Y.R. (2010). Organic spectroscopy, revised edition. S Chand publication.

3. Kenneth A. C. (2007). Textbook of Pharmaceutical Analysis ,3rd edition, Wiley publication.

4. Vogel A.I., (2000). Vogel's Textbook of Quantitative Chemical Analysis, 6th edition. Prentice hall publication.

5. Beckett A.H. and Stenlake J.B. Practical Pharmaceutical Chemistry. 4th edition (part 2), London: the Athlone press.

6. Finar I. L. (2002). Organic Chemistry 6th edition, India: Pearson Education India.
7. Kemp W. (2019). Organic spectroscopy, 3rd edition. USA: Palgrave

8. Garrett D. C. (1964). Quantitative Analysis of Drugs, 3rd edition, US: Springer.

9. Sethi P. D. (2019), Quantitative Analysis of Drugs in Pharmaceutical Formulations, 3rd edition. India: CBS publication.

10. Silverstein (2014). Spectrophotometric identification of Organic Compounds, 8th edition. Wiley publication.


**Teaching Learning Process and Assessment Methods:**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | The students will be able to understand the advanced instruments used and its applications in drug analysis | Traditional teaching, PPT | Class tests, assignments, mcq |
| **II** | The students will be able to learn about the chromatographic separation and analysis of drugs. | Traditional teaching, PPT | Class tests, assignemts, mcq |
| **III** | The students will be able to understand the calibration of various analytical instruments | Traditional teaching, PPT | Class tests, ass<br>ignemts, mcq |
| **IV** | The students will be able to learn about analysis of drugs using various analytical instruments. | Traditional teaching, PPT | Class tests, assignemts, mcq |

| **Paper XII:** | **Subject Paper :** DIETARY SUPPLEMENTS AND NUTRACEUTICALS | |
|---|---|---|
| **L-T-P-C – 3-1-0-4** | **Credit Units:4** | **Scheme of Evaluation: (T/P/TP)** |

**Objective:** This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.

**Course outcome:** This module aims to provide an understanding of the concepts behind the theoretical applications of dietary supplements. By the end of the course, students should be able to

1. Understand the need of supplements by the different group of people to maintain healthy life.

2. Understand the outcome of deficiencies in dietary supplements.

3. Appreciate the components in dietary supplements and the application.

4. Appreciate the regulatory and commercial aspects of dietary supplements including health claims.

| Module | Topics (if applicable)/course content | Hours |
|---|---|---|
| **I** | a. Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc.<br><br>b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community.<br><br>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. | **07 hours** |
| **II** | **Phytochemicals as nutraceuticals:** Occurrence and characteristic features(chemical nature medicinal benefits) of following<br><br>a) Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, leutin<br><br>b) Sulfides: Diallyl sulfides, Allyl trisulfide. c) Polyphenolics: Reservetrol<br><br>d) Flavonoids- Rutin , Naringin, Quercitin, Anthocyanidins, catechins, Flavones<br><br>e) Prebiotics / Probiotics.: Fructo oligosaccharides, Lacto bacillum<br><br>f) Phyto estrogens : Isoflavones, daidzein, Geebustin, lignans | **15 hours** |

| | | |
|---|---|---|
| | g) Tocopherols<br><br>h) Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like. | |
| **III** | a) **Introduction to free radicals**: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids.<br><br>b) Dietary fibres and complex carbohydrates as functional food ingredients.. | 07 hours |
| **IV** | a) Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals involvement in other disorders. Free radicals theory of ageing.<br><br>b) Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α- Lipoic acid, melatonin Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole.<br><br>c) Functional foods for chronic disease prevention<br><br>d) Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals.<br><br>e) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods.<br><br>f)Pharmacopoeial Specifications for dietary supplements and nutraceuticals | 16 hours |

References:

1. B. S.L. (2019), Dietetics, 8th edition, India: New Age International Private Limited.

2. Agusti K.T and Faizal P (2019), Role of dietary fibres and neutraceuticals in preventing diseases ,BSP Publication.

3.Cooper. K.A., (1997). Advanced Nutritional Therapies, 1st edition, USA: Thomas Nelson Inc

4. Carper J, (2000). The Food Pharmacy, Re-issue edition, Simon & Schuster publication.

5. Balch J.F., B and Balch P.A. (1997). Prescription for Nutritional Healing, 2nd Edition., New York:Avery Publishing Group.

6. Gibson G. and Williams C (2000). Functional foods, 1st edition, London: Woodhead Publication.

7. Goldberg I (1994). Functional Foods, 1st edition, New York: Chapman and Hall.

9. Wildman R.E.C. (2000). Handbook of Nutraceuticals and Functional Foods, 3rd Edition, CRC press.

10. Shils, ME, Olson, JA, Shike, M. (1994), Modern Nutrition in Health and Disease. 8th edition, Lea and Febiger.

**Teaching Learning Process and Assessment Methods:**

| **Unit No.** | **Course Learning Outcomes** | **Teaching and Learning Activity** | **Assessment Tasks** |
|---|---|---|---|
| **I** | The students will be able to Understand the need of supplements by the different group of people to maintain healthy life. | Traditional teaching, PPT | Class tests, assignments, mcq |
| **II** | The students will be able to Understand the outcome of deficiencies in dietary supplements. | Traditional teaching, PPT | Class tests, assignments, mcq |
| **III** | The students will be able to Appreciate the components in dietary supplements and the application. | Traditional teaching, PPT | Class tests, assignments, mcq |
| **IV** | The students will be able to<br>Appreciate the regulatory and commercial aspects of dietary supplements including health claims | Traditional teaching, PPT | Class tests, assignments, mcq |

| **Paper XIII/ Subject Paper:** ELECTIVE COURSE ON PHARMACEUTICAL PRODUCT DEVELOPMENT | | |
|---|---|---|
| **L-T-P-C – 3-1-0-4** | **Credit Units:4** | **Scheme of Evaluation: (T/P/TP)** |

**Course outcome:** After this course the student will be able to learn about pharmaceutical product development **and** the Pharmaceutical Excipients and their application.

| Module | Topics (if applicable)/course content | Hours |
|---|---|---|
| I | Introduction to pharmaceutical product development, objectives, regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms | 10 hours |
| II | An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Solvents and solubilizers ii. Cyclodextrins and their applications iii. Non - ionic surfactants and their applications iv. Polyethylene glycols and sorbitols v. Suspending and emulsifying agents vi. Semi solid excipients | 10 hours |
| III | An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Tablet and capsule excipients ii. Directly compressible vehicles iii. Coat materials iv. Excipients in parenteral and aerosols products v. Excipients for formulation of NDDS Selection and application of excipients in pharmaceutical formulations with specific industrial applications | 10 hours |
| IV | **Optimization techniques in pharmaceutical product development**:A study of various optimization techniques for pharmaceutical product development with specific examples.Optimization by factorial designs and their applications.A study of QbD and its application in pharmaceutical product development. Hours Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations. | 15 hours |

**Recommended Books (Latest editions)**

1. Bolton S, Charles B. (1991). Pharmaceutical Statistics Practical and Clinical Applications, 4th edition, Marcel Dekker Inc.

2. Swarbrick J. (2007). Encyclopedia of Pharmaceutical Technology, 3rd edition. Informa Healthcare publishers.

3. Lieberman H.A. and Leon L. (1989). Pharmaceutical Dosage Forms, Tablets, Volume II

2nd edition, New York: Marcel Dekker, Inc.

4. Khar Roop k, Vyas S P, Ahmad S P, Jain G. K, Farhan J Ahmad. (2013). The Theory and Practice of Industrial Pharmacy, 4th Edition, CBS Publishers and Distributors Pvt.Ltd.

5.. Sinko P.J, (2011), Martin's Physical Pharmacy and Pharmaceutical Sciences, 6th Edition, BI Publications Pvt. Ltd.

6. Vyas S. P. and Khar R. K. (2012). Targeted and Controlled Drug Delivery, Novel Carrier Systems, 1st Edition, CBS Publishers and Distributors Pvt. Ltd.

7. Loyd V. Allen Jr., Nicholas B.P (2011). Pharmaceutical Dosage Forms and Drug Delivery Systems, 9th edition. Howard C. Ansel.

8. Michael E.A. (2013). Aulton's Pharmaceutics – The Design and Manufacture of Medicines, 4th edition, Churchill Livingstone.

9. Remington J.P. , Gennaro A.R, (2000), Remington – The Science and Practice of Pharmacy, 20th edition. Lippincott Williams and Wilkin.

10. Liberman H.A., Martin, M.R and Gilbert S. B. (1996). Pharmaceutical Dosage Forms – Disperse Systems Vol 1 to 3, 2nd edition, CRC press.

12. Kenneth E. A. and Libermann H.A. (1985), Pharmaceutical Dosage Forms – Parenteral Medication, Volume I and II, 3rd edition, wiley-Liss Inc, A Wiley Company.

13. Advanced Review Articles related to the topics.

**Teaching Learning Process and Assessment Methods:**

| Unit No. | Course Learning Outcomes | Teaching and Learning Activity | Assessment Tasks |
|---|---|---|---|
| **I** | The students will be able to learn how pharmaceutical products are developed or formulated | Traditional teaching, PPT | Class tests, assignments, mcq |
| **II** | The students will be able to explore an advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference solvent, emulsifying agent, suspending agent etc | Traditional teaching, PPT | Class tests, assignments, mcq |
| **III** | The students will be able to explore an advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference tablets, | Traditional teaching, PPT | Class tests, assignments, mcq |

| | | | |
|---|---|---|---|
| | capsules, | | |
| **IV** | The students will be able to learn the optimization techniques in pharmaceutical product development | Traditional teaching, PPT | Class tests, assignments, mcq |