

# SYLLABUS

D.Pharm.

## ORDINANCE, SCHEME & SYLLABUS FOR DIPLOMA IN PHARMACY

|                             |  |
|-----------------------------|--|
| <b>Course Title:</b>        | Diploma in Pharmacy  |
| <b>Abbreviation:</b>        | D. Pharm.  |
| <b>Type of Course:</b>      | A Two years Diploma course   |
| <b>Pattern:</b>             | Yearly   |
| <b>Award of the Degree:</b> | Diploma will be awarded for those passing<br>in both the years as per rules and regulations. |

**O-D. Ph. 1. DURATION OF THE COURSE:** The duration of the course shall be for two academic years, with each academic year spread over a period of not less than one hundred and eighty working days in addition to 500 hours practical training spread over a period of not less than 3 months.

**O-D. Ph.2. ELIGIBILITY FOR ADMISSION:** No. Candidate shall be admitted to Diploma in Pharmacy Pt. I unless he/she had passed any of the following examinations in all the optional subjects and compulsory subjects (Physics, Chemistry, Biology and /or Mathematics including English as one of the Compulsory subjects):

- a) Intermediate examination in Science; The First Year of the three year degree course in Science; 10+2 Examination(Academic stream) in Science;
- b) Pre-degree examination; any other qualification approved by the Pharmacy Council of India as equivalent to any of the above exam.

Admission of candidates to the Diploma in Pharmacy Part - I shall be made in order of merit on the basis of 'Pre-Pharmacy Test' conducted in accordance with the scheme of Examinations and syllabus laid-down by the University.

### **O- D. Ph.3. ELIGIBILITY FOR APPEARING IN EXAMINATION**

- (a) Eligibility for appearing at the Diploma in Pharmacy Part-I Examination: Only such candidates who produce-certificate from the Head of the Academic Institution in which he/she has undergone the Diploma in Pharmacy Part-I course, in proof of his/her having regularly and satisfactorily undergone the course of study by attending not less than 75% of the classes held both in theory and in practical separately in each, shall be eligible for appearing at the Diploma in Pharmacy (Part-I) examination.
- (b) Eligibility for appearing at the Diploma in Pharmacy Part-II Examination: Only such candidates who produce certificate from the Head of the academic institution in which he/she has undergone the Diploma in Pharmacy Part-II course, in proof of his/her having regularly and satisfactorily attending not less than 75% of the classes held both in theory and practicals separately in each subject, shall be eligible for appearing at the Diploma in Pharmacy (Part-II) examination.
- (c) A candidate can have a relaxation of 10% attendance on medical ground by producing a certificate from medical officer of government hospital and a 5% relaxation by the vice chancellor on the recommendation of Dean, faculty.

**O-D. Ph. 4.GENERAL**

(A) **Course of Study:** The course of study for Diploma in Pharmacy part-I and Diploma in pharmacy part-II shall include the subjects as given in the Tables I & II below. The number of hours devoted to each subject for its teaching is given against columns 2 and 3 of the Tables below.

**TABLE-I Diploma in Pharmacy (Part-I)**

| Subject                               | Theory      |             | Practical   |             |
|---------------------------------------|-------------|-------------|-------------|-------------|
|                                       | hours /year | Hrs. / week | hours /year | Hrs. / week |
| Pharmaceutics-I                       | 75          | 3           | 100         | 4           |
| Pharmaceutical Chemistry-I            | 75          | 3           | 75          | 3           |
| Pharmacognosy                         | 75          | 3           | 75          | 3           |
| Biochemistry & Clinical Pathology     | 50          | 2           | 75          | 3           |
| Human Anatomy & Physiology            | 75          | 3           | 50          | 2           |
| Health Education & community pharmacy | 50          | 2           |             |             |
|                                       | 400         | 16          | 375         | 15          |

**TABLE-II Diploma in Pharmacy (Part-II)**

| Subject                            | Theory      |             | Practica l  |             |
|------------------------------------|-------------|-------------|-------------|-------------|
|                                    | hours /year | Hrs. / week | hours /year | Hrs. / week |
| Pharmaceutics-II                   | 75          | 3           | 100         | 4           |
| Pharmaceutical Chemistry-II        | 100         | 4           | 75          | 3           |
| Pharmacology & Toxicology          | 75          | 3           | 50          | 2           |
| Pharmaceutical Jurisprudence       | 50          | 2           | -           |             |
| Drug store and Business Management | 75          | 3           | -           |             |
| Hospital & Clinical Pharmacy       | 75          | 3           | 50          | 2           |
|                                    | 450         | 18          | 275         | 11          |

(b) Examinations: There shall be an examination for Diploma in Pharmacy (part-I) to examine students of the first year course and an examination for Diploma in Pharmacy (part-II) to examine students of the second year course. Each examination may be held twice every year. The first examination in every year shall be the annual examination and the second examination shall be supplementary examination of the Diploma in Pharmacy (part-I) or Diploma in pharmacy (Part-II) as the case may be. The examinations shall be of written and practical (including oral) nature. Carrying maximum marks for each part of subject, as indicated in Table III and IV:R-29(A) (Plan and scheme of examination for Diploma in Pharmacy).

**O-D. Ph.5. PRACTICAL TRAINING**

Diploma in Pharmacy (Part-III)

(a) Period and other conditions of practical training:

After having appeared in Part-II examination of Diploma in Pharmacy conducted by Board/University or other approved examination Body or any other course accepted as being equivalent by the Pharmacy Council of India, a candidate shall be eligible to undergo practical training in one or more of the following institutions namely:

Hospitals/Dispensaries run by Central/State Government/Municipal corporations/ central Government Health scheme and Employees state Insurance scheme. A pharmacy, chemist and Druggist licensed under the Drugs and cosmetics Rules, 1945 made under the Drugs and Cosmetics Act, 1940(23 of 1940). The institutions referred in sub-regulation(1) shall be eligible to impart training subject to the condition that the number of student pharmacists that may be taken in any Hospital, pharmacy, Chemist and Druggist licensed under the Drugs and cosmetics Rules, 1945 made under the

Drugs and cosmetics Act,1940 shall not exceed two where there is one registered pharmacist engaged in the work in which the student pharmacist is under going practical training, where there is more than one registered pharmacist similarly engaged, the number shall not exceed one for each additional such registered pharmacist. Hospital and Dispensary other than those specified in sub-regulation(1)for the purpose of giving practical training shall have to be recognized by pharmacy council of India on fulfilling the conditions specified in Appendix-D to these regulations.

In the course of practical training, the trainees shall have exposure to: Working knowledge of keeping of records required by various acts concerning the profession of pharmacy and Practical experience in the manipulation of pharmaceutical apparatus in common use, the reading, translation and copying of prescription including checking of dose, the dispensing of prescriptions illustrating the commoner methods of administering medicaments; the storage of drugs and medical preparations. The practical training shall be not less than five hundred hours spread over a period of not less than three months provided that not less than two hundred and fifty hours and devoted to actual dispensing of prescriptions.

**(b) Procedure to be followed prior to commencing of the training:**

The head of the academic training institution, shall supply application in triplicate in ' Practical Training Contract Form for Qualification as pharmacist' to candidate eligible to under-take the said practical training, the contract form shall be as specified in Appendix-E to these regulations.

The head of an academic training institution shall fill section I of the contract Form. The trainee shall fill section II of the said contract Form and the Head of the institution agreeing to impart the training (hereinafter referred to as the Apprentice Master) shall fill section III of the said contract Form.

It shall be the responsibility of the trainee to ensure that one copy (hereinafter referred to as the first copy of the contract Form)so filled is submitted to Head of the academic training institution and the other two copies(hereinafter referred to as the second copy and the third copy)shall be filled with Apprentice Master(if he so desires)or with the trainee pending completion of the training.

- (c) Certificate of Passing Diploma in Pharmacy(part-III) on satisfactory completion of the apprentice period, the Apprentice Master shall fill Section IV of the second copy and third copy of contract form and cause it to be sent to the head to the academic training institution who shall suitably enter in the first copy of the entries from the second copy and third copy and shall fill section V of the three copies of contract form and thereafter handover both the second copy and the third copy to the trainee. Thus, if completed in all respect, shall be regarded as a certificate of having successfully completed the course of Diploma in Pharmacy (part-III).

**O-D. Ph.6. Working out of Result**

**(a) Mode of examinations:**

Each theory and practical examination in the subject mentioned in Table-III and IV shall be of three hours duration. A candidate who fails in theory or practical examination shall reappear in such theory or practical paper(s) as the case may be. Practical examination shall also consist of viva voce (oral) examination.

**(b) Award of sessional marks and maintenance of records:**

A regular record of both theory and practical class work and examinations conducted in an institution imparting training for Diploma in Pharmacy Part-I and Diploma in pharmacy Part-II courses, shall be maintained for each student in the institution and 20 marks for each theory and 20 marks for each practical subject shall be allotted as sessional.

There shall be at least three periodic sessional examinations during each academic year. The highest aggregate of any two performances shall form the basis of calculating sessional marks.

The sessional marks in practicals shall be allotted on the following basis:

|  |    |
|--|----|
| Actual performance in the sessional examination.   | 10 |
| Day to day assessment in the practical class work. | 10 |

- (c) Minimum marks for passing the examination: A student shall not be declared to have passed Diploma in Pharmacy examination unless he/she secures atleast 40% marks in each of the subject separately in theory examination, including sessional marks and atleast 40% marks in each of the practical examination including sessional marks. The candidates securing 60% marks or above in aggregate in

all subjects in a single attempt at the Diploma in Pharmacy (part-I) or Diploma in Pharmacy (part-II) examinations shall be declared to have passed in first class the Diploma in Pharmacy (part-I) or Diploma in Pharmacy (part-II) examinations, as the case may be. Candidates securing 75% marks or above in any subject or subjects provided he/she passes in all the subjects in single attempt, will be given distinction in that subjects(s).

- (d) Eligibility for Promotion to Diploma in Pharmacy (Pt. II): All candidates who have appeared for all the subjects and passed the Diploma in pharmacy part-I class. However failure in more than two subjects (each Theory paper or practical examination shall be considered as a subject) shall debar him/her from promotion to the Diploma in Pharmacy Part-II class. Such candidates shall be examined in the failing subjects only at subsequent. A candidate who fails to pass D Pharm Part - I exam. in four attempts shall not allowed to continue the course.
- (e) Improvement of sessional marks: Candidates who wish to improve sessional marks can do so by appearing in two additional sessional examinations during the next academic year. The average score of the two examinations shall be the basis for improved sessional marks in theory. The sessional of practicals shall be improved by appearing in additional practical examinations. Marks awarded to a candidate for day to day assessment in the practical class, can not be improved unless he/she attends regular course of study again.
- (f) Certificate of passing examination for Diploma in Pharmacy (part-II): Certificate of having passes the examination for the Diploma in pharmacy Part-II shall be granted by the Examining Authority to a successful student.
- (g) Certificate of Diploma in Pharmacy: A certificate of Diploma in pharmacy shall be granted by the Examining Authority to successful candidate on producing certificate of having passed the Diploma in Pharmacy part-I and Part-II and satisfactory completion of practical training for Diploma in pharmacy (part-III).
- (h) The chairman and at least one expert member of examining committee of the Examining Authority Concerned with appointment of examiners and conduct of pharmacy examination should be persons possessing pharmacy Qualifications.

**PLAN AND SCHEME OF EXAMINATION FOR THE DIPLOMA IN PHARMACY**

(Based on effective teaching for 180 working days in one academic session)

**Table-III Diploma in pharmacy (part-I) Examination**

| Subject                               | Max. Marks in Theory |           |       | Max. Marks in Practical |           |       |
|---------------------------------------|----------------------|-----------|-------|-------------------------|-----------|-------|
|                                       | Examination          | Sessional | Total | Examination             | Sessional | Total |
| Pharmaceutics-I                       | 80                   | 20        | 100   | 80                      | 20        | 100   |
| Pharmaceutical Chemistry-I            | 80                   | 20        | 100   | 80                      | 20        | 100   |
| Pharmacognosy                         | 80                   | 20        | 100   | 80                      | 20        | 100   |
| Biochem. & Clinical Pathology         | 80                   | 20        | 100   | 80                      | 20        | 100   |
| Human Anatomy & Physiology            | 80                   | 20        | 100   | 80                      | 20        | 100   |
| Health Education & community pharmacy | 80                   | 20        | 100   |                         |           |       |
|                                       |                      |           | 600   |                         |           | 500   |

**TABLE-IV Diploma in Pharmacy (Part-II)**

| Subject                            | Max. Marks in Theory |           |       | Max. Marks in Practical |           |       |
|------------------------------------|----------------------|-----------|-------|-------------------------|-----------|-------|
|                                    | Examination          | Sessional | Total | Examination             | Sessional | Total |
| Pharmaceutics-II                   | 80                   | 20        | 100   | 80                      | 20        | 100   |
| Pharmaceutical Chemistry-II        | 80                   | 20        | 100   | 80                      | 20        | 100   |
| Pharmacology & Toxicology          | 80                   | 20        | 100   | 80                      | 20        | 100   |
| Pharmaceutical Jurisprudence       | 80                   | 20        | 100   |                         |           |       |
| Drug store and Business Management | 80                   | 20        | 100   |                         |           |       |
| Hospital & Clinical Pharmacy       | 80                   | 20        | 100   | 80                      | 20        | 100   |
|                                    |                      |           | 600   |                         |           | 400   |

Note: Each paper shall consist of six questions out of which five shall be attempted. Half of the total number of papers in each year will be set and assessed by external examiners and the remaining half will be set and assessed by the internal examiners. There shall be one external and one internal examiner for each practical Examination.

# SYLLABUS

## DIPLOMA IN PHARMACY (PART-I)

### 1.1 PHARMACEUTICS I

#### Theory (75 Hours)

**Introduction of different dosage forms.** Their classification with examples-their relative applications. Familiarization with new drug delivery systems. Introduction to Pharmacopoeias with special reference to the Indian Pharmacopoeia.

**Metrology**-System of weights and measures. Calculations including conversion from one to another system. Percentage calculations and adjustment of products .Use of alligation method in calculations .Isotonic solutions.

**Packaging of pharmaceuticals**-Desirable features of a container and types of containers. Study of glass & plastics as materials for containers and rubber as a material for closure-their merits and demerits. Introduction to aerosol packaging. Size reduction, objectives, and factors affecting size reduction, methods of size reduction- study of Hammer mill, ball mill, Fluid energy mill and Disintegrator.

**Size separation**-size separation by sifting. Official standards for powders. Sedimentation methods of size separation. Construction and working of Cyclone separator.

**Mixing and Homogenization**-Liquid mixing and powder mixing, Mixing of semisolids. Study of silverson Mixer-Homogenizer, planetary Mixer; Agitated powder mixer; Triple Roller Mill; Propeller Mixer, colloid Mill and Hand Homogeniser. Double cone mixer.

**Clarification and Filtration**-Theory of filtration, Filter media; Filter aids and selection of filters. Study of the following filtration equipments-Filter Press, sintered filters, Filter candles, Metafilter.

#### **Extraction and Galenicals-**

(a) Study of percolation and maceration and their modification, continuous hot extraction-Application in the preparation of tinctures and extracts.

(b) Introduction to Ayurvedic dosage forms. Heat process-Evaporation-Definition-Factors affecting evaporation-study of evaporating still and Evaporating pan.

**Distillation**-Simple distillation and Fractional distillation, steam distillation and vacuum distillation. Study of vacuum still, preparation of purified water I.P. and water for Injection I.P. construction and working of the still used for the same.

**Introduction to drying process**-Study of Tray Dryers; Fluidized Bed Dryer, Vacuum Dryer and Freeze Dryer.

**Sterilization**-Concept of sterilization and its differences from disinfection-Thermal resistance of microorganisms. Detailed study of the following sterilization process. Sterilization with moist heat, Dry heat sterilization, Sterilization by radiation, Sterilization by filtration and Gaseous sterilization.

**Aseptic techniques**-Applications of sterilization process in hospitals particularly with reference to surgical dressings and intravenous fluids. Precautions for safe and effective handling of sterilization equipment.

**Processing of Tablets**-Definition; different type of compressed tables and their properties. Processes involved in the production of tablets; Tablets excipients ; Defects in tablets; Evaluation of Tablets; Physical standards including Disintegration and Dissolution. Tablet coating-sugar coating; films coating, enteric coating and micro-encapsulation (Tablet coating may be de.. in an elementary manner).

**Processing of Capsules**-Hard and soft gelatin capsules; different sizes of capsules; filling of capsules; handling and storage of capsules. Special applications of capsules.

**Study of immunological products** like sera, vaccines, toxoids & their preparations.

### **PRACTICAL (100 hours)**

Preparation (minimum number stated against each of the following categories illustrating different techniques involved.

1. Aromatic waters<sup>3</sup>
2. Solutions <sup>4</sup>
3. Spirits<sup>2</sup>
4. Tinctures<sup>4</sup>
5. Extracts<sup>2</sup>
6. Creams<sup>2</sup>
7. Cosmetic preparations<sup>3</sup>
8. Capsules<sup>2</sup>
9. Tables<sup>2</sup>
10. Preparations involving<sup>2</sup>
11. Ophthalmic preparations<sup>2</sup>
12. Preparations involving aseptic techniques<sup>2</sup>

#### **Books recommended:(Latest editions)**

- 1.) Remington's Pharmaceutical Sciences.
- 2.) The Extra Pharmacopoeia-Martindale.

## **1.2 PHARMACEUTICAL CHEMISTRY-I**

### **THEORY (75 Hours)**

General discussion on the following inorganic compounds including important physical and chemical properties, medicinal and pharmaceutical uses, storage conditions and chemical incompatibility.

**Acids, bases and buffers**-Boric acid, Hydrochloric acid, Strong Ammonium hydroxide, Sodium hydroxide and official buffers.

**Antioxidants**- Hypophosphorous acid, Sulphur dioxide, Sodium bisulphite, Sodium meta-bisulphite, Sodium thiosulphate, Nitrogen and Sodium nitrite.

#### **Gastrointestinal agents-**

Acidifying agents- Dilute Hydrochloric acid.

Antacids- Sodium bicarbonate, Aluminum hydroxide gel, Aluminum phosphate, Calcium carbonate, Magnesium carbonate, Magnesium trisilicate, Magnesium oxide, Combinations of antacid preparations.

Protective and Adsorbents- Bismuth sub carbonate and Kaolin.

Saline cathartics- Sodium potassium tartrate and Magnesium sulphate.

#### **Topical Agents-**

Protective- Talc, Zinc Oxide, Calamine, Zinc stearate, Titanium dioxide, silicone polymers.



**Antimicrobials and Astringents-** Hydrogen peroxide\*, Potassium permanganate, Chlorinated lime, Iodine, Solutions of Iodine, Povidone-iodine, Boric acid, Borax, Silver nitrate, Mild silver protein, Mercury yellow, Mercuric oxide, Ammoniated mercury.

Sulphur and its compounds- Sublimed sulphur, Percipitated sulphur, Selenium sulphide.

Astringents- Alum and Zinc Sulphate.

**Dental Products-** Sodium fluoride, Stannous fluoride, Calcium carbonate, Sodium meta phosphate, Dicalcium phosphate, Strontium chloride, Zinc chloride.

Inhalants- Oxygen, Carbon dioxide, Nitrous oxide.

**Respiratory stimulants-** Ammonium carbonate.

**Expectorants and Emetics-** Ammonium chloride\*, Potassium iodide, Antimony potassium tartrate.

**Antidotes-** Sodium nitrite.

**Major Intra and Extra cellular electrolytes-**

Electrolytes used for replacement therapy- Sodium chloride and its preparations, Potassium chloride and its preparations.

Physiological acid-base balance and electrolytes used- Sodium acetate, Potassium Acetate, Sodium bicarbonate Inj., Sodium citrate, Potassium citrate, Sodium lactate injection, Ammonium chloride and its injection.

Combination of oral electrolyte powders and solutions.

**Inorganic official compounds** of Iron, Iodine and Calcium, Ferrous Sulphate and Calcium Gluconate.

**Radio pharmaceuticals and contrast media-** Radio activity-Alpha; Beta and Gamma Radiations, Biological effects of radiations, Measurement of radio activity, G.M. Counter, Radio isotopes-their uses, Storage and precautions with special reference to the official preparations. Radio opaque contrast media- Barium sulfate.

**Quality control of Drugs and pharmaceuticals-** Importance of quality control, significant errors, methods used for quality control, sources of impurities in pharmaceuticals. Limit tests for Arsenic, Chloride, Sulfate, Iron and Heavy metals.

**Identification tests** for cations and anions as per Indian Pharmacopoeia.

### **PRACTICAL (75 hours)**

1. Identification tests for inorganic compounds particularly drugs and pharmaceuticals.
2. Limit test for chloride, Sulfate, Arsenic, Iron and Heavy metals.
3. Assay of inorganic pharmaceuticals involving each of the following methods of compounds marked with (\*) under theory.
  - i. Acid-Base titrations(at least 3)
  - ii. Redox titrations (one each of permanganometry and iodimetry).
  - iii. Precipitation titrations (at least 2)
  - iv. Complexometric titration (Calcium and Magnesium).

### **Books recommended (Latest editions)**

1. Indian pharmacopoeia.

## 1.3 PHARMACOGNOSY

### THEORY (75 Hours)

1. Definition, history and scope of Pharmacognosy including indigenous system of medicine.
2. Various systems of classification of drugs and natural origin.
3. Adulteration and drug evaluation; significance of pharmacopoeial standards.
4. Brief outline of occurrence, distribution, outline of isolation, identification tests, therapeutic effects and pharmaceutical application of alkaloids, terpenoids, glycosides, volatile oils, tannins and resins.
5. Occurrence, distribution, organoleptic evaluation, chemical constituents including tests wherever applicable and therapeutic efficacy of following categories of drugs.

- (a) **Laxatives**- Aloes, Rhubarb, Castor oil, Ispaghula, Senna.
- (b) **Cardiotonics**- Digitalis, Arjuna.
- (c) **Carminatives & G.I. regulators**- Umbelliferous fruits, Coriander, Fennel, Ajowan, Cardamom, Ginger, Black pepper, Asafoetida, Nutmeg, Cinnamon, Clove.
- (d) **Astringents**- Catechu.
- (e) **Drugs acting on nervous system**- Hyoscyamus, Belladonna, Aconite, Ashwagandha, Ephedra, Opium, Cannabis, Nux -vomica.
- (f) **Antihypertensive**- Rauwolfia.
- (g) **Antitussives**- Vasaka, Tolu balsam, Tulsi.
- (h) **Antirheumatics**- Guggal, Colchicum.
- (i) **Antitumour**- Vinca.
- (j) **Antileprotics**- Chaulmoogra oil.
- (k) **Antidiabetics**- Pterocarpus, Gymnema sylvestro.
- (l) **Diuretics**- Gokhru, Punarnava.
- (m) **Antidysenterics**- Ipecacuanha.
- (n) **Antiseptics and disinfectants**- Benzoin, Myrrh, Neem, Curcuma.
- (o) **Antimalarials**- Cinchona.
- (p) **Oxytocics**- Ergot.
- (q) **Vitamins**- Shark liver oil and Amla.
- (r) **Enzymes**- Papaya, Diastase, Yeast.
- (s) **Perfumes and flavoring agents**- peppermint oil, Lemon oil, Orange oil, lemon grass oil, sandal wood.

**Pharmaceutical aids**-Honey, Arachis oil, starch, kaolin, pectin, olive oil. Lanolin, Beeswax, Acacia, Tragacanth, sodium Alginate, Agar, Guar gum, Gelatin.

**Miscellaneous**- Liquorice, Garlic, picrorhiza, Dirscorea, Linseed, shatavari, shankpushpi, pyrethrum, Tobacco.

Collection and preparation of crude drugs for the market as exemplified by Ergot, opium, Rauwalfia, Digitalis, senna.

Study of source, preparation and identification of fibers used in sutures and surgical dressings-cotton, silk, wool and regenerated fibers.

Gross anatomical studies of-senna, Datura, cinnamon, cinchona, fennel, clove, Ginger, Nuxvomica & ipecacuanha.

### PRACTICAL (75 hours)

1. Identification of drugs by morphological characters. Physical and chemical tests for evaluation of drugs wherever applicable.
2. Gross anatomical studies(t.s.)of the following drugs :Senna, Datura, cinnamon, cinchona, coriander, fennel, clove, Ginger, Nux-vomica, Ipecacuanha.
3. Identification of fibers and surgical dressing.

## 1.4 BIOCHEMISTRY AND CLINICAL PATHOLOGY

### THEORY (50 Hours)

**Introduction to biochemistry.** Brief chemistry and role of proteins, polypeptides and amino acids, classification, Qualitative tests, Biological value, Deficiency diseases.

**Carbohydrates:** Brief chemistry and role of carbohydrates, classification, qualitative tests, Diseases related to carbohydrate metabolism.

**Lipids:** Brief chemistry and role of lipids, classification and qualitative tests. Diseases related to lipids metabolism.

**Vitamins:** Brief chemistry and role of vitamins and coenzymes. Role of minerals and water in life processes.

**Enzymes:** Brief concept of enzymatic action. factors affecting it.

**Therapeutics:** Introduction to pathology of blood and urine. Lymphocytes and platelets, their role in health and disease. Erythrocytes-Abnormal cells and their significance. Abnormal constituents of urine and their significance in diseases.

### **PRACTICAL (75 Hours)**

1. Detection and identification of proteins. Amino acids, carbohydrates and lipids.
2. Analysis of normal and abnormal constituents of Blood and Urine (Glucose, urea, creatine, creatinine, cholesterol, alkaline phosphatase acid phosphatase, Bilirubin, SGPT, SGOT, calcium, Diastase, Lipase).
3. Examination of sputum and faeces (microscopic & staining).
4. Practice in injecting drugs by intramuscular, subcutaneous and intravenous routes, withdrawal of blood samples.

## **1.5 HUMAN ANATOMY AND PHYSIOLOGY**

### **THEORY(75 Hours)**

**Scope of Anatomy and physiology.** Definition of various terms used in Anatomy. Structure of cell, function of its components with special reference to mitochondria and microsomes.

**Elementary tissues:** Elementary tissues of the body, i.e. epithelial tissue, muscular tissue, connective tissue and nervous tissue.

**Skletal System:** Structure and function of Skelton .Classification of joints and their function. Joint disorders.

**Cardiovascular System:** Composition of blood, functions of blood elements. Blood group and coagulation of blood. Brief information regarding disorders of blood. Name and functions of lymph glands. Structure and functions of various parts of the heart .Arterial and venous system with special reference to the names and positions of main arteries and veins. Blood pressure and its recording. Brief information about cardiovascular disorders.

**Respiratory system:** Various parts of respiratory system and their functions, physiology of respiration.

**Urinary System:** Various parts of urinary system and their functions, structure and functions of kidney. Physiology of urine formation. Patho-physiology of renal diseases and edema.

**Muscular System:** Structure of skeletal muscle, physiology of muscle contraction. Names, positions, attachments and functions of various skeletal muscles. physiology of neuromuscular junction.

**Central Nervous System:** Various parts of central nervous system, brain and its parts, functions and reflex action. Anatomy and physiology of automatic nervous system.

**Sensory Organs:** Elementary knowledge of structure and functions of the organs of taste, smell, ear, eye and skin. Physiology of pain.

**Digestive System:** names of various parts of digestive system and their functions. structure and functions of liver, physiology of digestion and absorption.

**Endocrine System:** Endocrine glands and Hormones. Location of glands, their hormones and functions. pituitary, thyroid. Adrenal and pancreas

**Reproductive system:** Physiology and Anatomy of Reproductive system.

### **PRACTICALS (50 hours)**

1. Study of the human Skelton.
2. Study with the help of charts and models of the following system and organs:  
Digestive system                      Respiratory system                      Ear  
Cardiovascular system                      Urinary system  
Reproductive system                      Eye
3. Microscopic examination of epithelial tissue, cardiac muscle, smooth muscle, skeletal muscle. Connective tissue and nervous tissues.
4. Examination of blood films for TLC.DLC and malarial parasite.
5. Determination of RBCs, clotting time of blood, erythrocyte sedimentation rate and Hemoglobin value.
6. Recording of body temperature, pulse, heart-rate, blood pressure and ECG.

## **1.6 HEALTH EDUCATION AND COMMUNITY PHARMACY**

### **THEORY (50 hours)**

**Concept of health:** Definition of physical health, mental health, social health, spiritual health determinants of health, indicatory of health, concept of disease, natural history of diseases, the disease agents, concept of prevention of diseases.

**Nutrition and health:** Classification of foods, requirements, diseases induced due to deficiency of proteins, vitamins and minerals-treatment and prevention.

**Demography and family planning:** Demography cycle, fertility, family planning, contraceptive methods, behavioral methods, natural family planning methods, chemical methods, mechanical methods, hormonal contraceptives, population problem of India.

**First aid:** Emergency treatment in shock, snake-bite, burns, poisoning, heart disease, fractures and resuscitation methods, Elements of minor surgery and dressings.

**Environment and health:** Source of water supply, water pollution, purification of water, health and air, noise, light-solid waste disposal and control-medical entomology, arthropod borne diseases and their control. rodents, animals and diseases.

**Fundamental principles of microbiology:** Classification of microbes, isolation, staining techniques of organisms of common diseases.

**Communicable diseases:** Causative agents, mode of transmission and prevention. Respiratory infections-chicken pox, measles, influenza, diphtheria, whooping cough and tuberculosis.

**Intestinal infection-**poliomyelitis, Hepatitis, cholera, Typhoid, food poisoning, Hookworm infection.

**Arthropod borne infections-**plague, Malaria, filariases.

**Surface infection-**Rabies, Trachoma, Tetanus, Leprosy.

**Sexually transmitted diseases-**Syphilis, Gonorrhoea, AIDS.

**Non-communicable diseases:** causative agents, prevention, care and control.

**Epidemiology:** Its scope, methods, uses, dynamics of disease transmission. Immunity and immunization: Immunological products and their dose schedule. Principles of disease control and prevention, hospital acquired infection, prevention and control. Disinfection, types of disinfection procedures, for-faces, urine, sputum, room linen, dead-bodies, instruments.

## 2.1 PHARMACEUTICS II (Dispensing Pharmacy)

### THEORY (75 Hours)

**Prescriptions**-Reading and understanding of prescriptions; Latin terms commonly used (Detailed study is not necessary), Modern methods of prescribing, adoption of metric system. Calculations involved in dispensing.

**Incompatibilities in prescriptions**- study of various types of incompatibilities-physical, chemical and therapeutic.

**Posology**- Dose and dosage of drugs, factors influencing dose, calculations of doses on the basis of age, sex, surface area and veterinary doses.

**Dispensed Medications:** (Note: A detailed study of the following dispensed medication is necessary. Methods of preparation with theoretical and practical aspects, use of appropriate containers and closures. special labeling requirements and storage conditions should be high-lighted).

**Powders**-Type of powders-Advantages and disadvantages of powders, Granules, cachets and tablet triturates. preparation of different types of powders encountered in prescriptions. Weighing methods, possible errors in weighing, minimum weighable amounts and weighing of a material below the minimum weighable amount, geometric dilution and proper usage and care of dispensing balance.

#### Liquid oral Dosage forms:

**Monophasic**-Theoretical aspects including commonly used vehicles, essential adjuvant like stabilizers, colorants and flavors, with examples.

Review of the following monophasic liquids with details of formulation and practical methods. Liquids for internal administration Liquids for external administration or used on mucous membranes

Mixtures and concentrates, Gargles

Syrups Mouth washes

Throat-paints

Elixirs

Douches

Ear Drops

Nasal drops

Sprays

Liniments

Lotions.

#### Biphasic Liquid Dosage Forms:

**Suspensions** (elementary study)-Suspensions containing diffusible solids and liquids and their preparations. Study of the adjuvant used like thickening agents, wetting agents, their necessity and quantity to be incorporated ,suspensions of precipitate forming liquids like tinctures, their preparations and stability. suspensions produced by chemical reaction. An introduction to flocculated /non-flocculated suspension system.

**Emulsions**-Types of emulsions, identification of emulsion system, formulation of emulsions, selection of emulsifying agent. Instabilities in emulsions, preservation of emulsions.

#### Semi-Solid Dosage Forms:

**Ointments:** Types of ointments, classification and selection of dermatological vehicles. Preparation and stability of ointments by the following processes:

Trituration

fusion

chemical reaction

Emulsification.

**Pastes:** Differences between ointments and pastes, Bases of pastes. preparation of pastes and their preservation .

**Jellies:** An introduction to the different types of jellies and their preparation.

An elementary study of poultice.

**Suppositories and peassaries**-Their relative merits and demerits, types of suppositories, suppository bases , classification, properties. preparation and packing of suppositories. Use of suppositories of drug absorption.

**Dental and cosmetic preparations:** Introduction to Dentifrices, facial cosmetics, Deodorants. Anti-perspirants, shampoo, Hair dressings and Hair removers.

**Sterile Dosage forms:**

**Parenteral dosage forms**-Definition, General requirements for parenteral dosage forms. Types of parenteral formulations, vehicles, adjuvant, processing and personnel, Facilities and quality control. Preparation of Intravenous fluids and admixtures-Total parenteral nutrition, Dialysis fluids.

**Sterility testing:** particulate matter monitoring- Faculty seal packaging.

**Ophthalmic products:** study of essential characteristics of different ophthalmic preparations. Formulation: additives, special precautions in handling and storage of ophthalmic products.

### **PRACTICAL (100 hours)**

Dispensing of at least 100 products covering a wide range of preparations such as mixtures, emulsion, solutions, liniments, E.N.T. preparations. Ointments, suppositories, powders, incompatible prescriptions etc.

#### **Books recommended: (Latest editions)**

1. Indian Pharmacopoeia.
2. British pharmacopoeia.
3. National formularies(N.F.I.,B.N.P)
4. Remington's pharmaceutical sciences.
5. Martindale's Extra pharmacopoeia.

## **2.2 PHARMACEUTICAL CHEMISTRY II**

### **THEORY (100 hours)**

1. Introduction to the nomenclature of organic chemical systems with particular reference to hetero-cyclic system containing up to 3 rings.
2. The chemistry of following pharmaceutical organic compounds covering their nomenclature, chemical structure, uses and the important physical and chemical properties(chemical structure of only those compounds marked with asterisk (\*). The stability and storage conditions and the different type of pharmaceutical formulations of these drugs and their popular brand names.

**Antiseptics and Disinfectants**-Proflavine\*, Benzalkonium chloride, Cetrimide, Phenol, chloroxylenol, Formaldehyde solution, Hexachlophene, Nitrofurantoin.

**Sulphonamides**- Sulphadiazine, Sulphaguanidine, Phthalylsulphathiazole, Succinylsulphathiazole, Sulphadimethoxine, Sulphamethoxyipyridazine, Co-trimoxazole, sulfacetamide\*

**Antileprotic Drugs**- Clofazimine , Thiambutosine, Dapsone\*, solapsone,

**Anti-tubercular Drugs**- Isoniazid\*, PAS\*, Streptomycin, Rifampicin, Ethambutol\*, Thiacetazone, Ethionamide, cycloserine, pyrazinamide\*.

**Antimoebic and Anthelmintic Drugs**- Emetine, Metronidazole, Halogenated hydroxyquinolines, Diloxanide furoate, Paromomycin , Piperazine\*, Mebendazole ,D.E.C.\*

**Antibiotics**- Benzyl penicillin\*, Phenoxy methyl penicillin\*, Benzathine penicillin, Ampicillin\*, Cloxacillin, Carbencicillin, Gentamicin, Neomycin, Erythromycin, Tetracycline, Cephalixin, Cephaloridine, Cephalothin, Griseofulvin, Chloramphenicol.

**Antifungal agents**- Udecylenic acid, Tolnaftate, Nystatin, Amphotericin, Hamycin.

**Antimalarial Drugs**-Chloroquine\*,Amodiaquine, Primaquine, Proguanil, Pyrimethamine\*, Quinine, Trimethoprim.

**Tranquilizers**-Chlorpromazine\*, Prochlorperazine, Trifluoperazine, Thiothixene, Haloperidol\*, Triperidol, Oxypertine, Chlordizepoxide, Diazepam\*, Lorazepam, Meprobamate.

**Hypnotics**- Phenobarbitone\*, Butobarbitone, Cylobarbitone, Nitrazepam, Glutethimide\*, Methypylon, Paraldehyde, Triclofosodium.

**General Anaesthetics**-Halothane\*, Cyclopropane\*, Diethyl ether\*, Methohexital sodium, Thiopecal sodium, Trichloroethylene .

**Antidepressant Drugs**- Amitriptyline, Nortriptyline, Imperamine\*, Phepeltzine, Tranlycypromine.

**Analeptics**- Theophylline, Caffeine\*, Coramine\*, Dextro-amphetamine.

**Adrenergic drugs-** Adrenaline\*, Noradrenaline, Isoprenaline\*, Phenylephrine, Salbutamol, Terbutaline, Ephedrine\*, Pseudoephedrine.

**Adrenergic antagonist-** Tolazoline, Propranolol\*, Practolol.

**Cholinergic Drugs-** Neostigmine\*, Pyridostigmine, Pralidoxime, Pilocarpine, Physostigmine\*.

**Cholinergic Antagonists-** Atropine\*, Hyoscine, Homatropine, Propantheline\*, Benztropine, Tropicamide, Biperiden\*.

**Diuretic Drugs-** Furosemide\*, Chlorothiazide, Hydrochlorothiazide\*, Benzthiazide, Urea\*, Mannitol\*, Ethacrynic Acid.

**Cardiovascular Drugs-** Ethylnitrite\*, Glyceryl trinitrate, Alpha methyl dopa, Guanethidine, Clofibrate, Quinidine.

**Hypoglycemic Agents-** Insulin, Chlorpropamide\*, Tolbutamide, Glibenclamide, Phenformin\*, Metformin.

**Coagulants and Anti coagulants-** Heparin, Thrombin, Menadione\*, Bisphydroxy-coumarin, Warfarin sodium.

**Local Anaesthetics-** Lignocaine\*, Procaine\*, Benzocaine,

**Histamine and anti Histaminic Agents-** Histamine, Diphenhydramine\*, Promethazine, Cyproheptadine, Mepyramine\*, Pheniramine, Chlorpheniramine\*,

**Analgesics and Anti-pyretics-** Morphine, Pethidine, Codeine, Methadone, Aspirin\*, Paracetamol, Analgin, Dextropropoxyphene, Pentazocine.

**Non-steroidal anti-inflammatory agents-** Indomethacin\*, Phenylbutazone\*, Oxyphenbutazone, Ibuprofen.

**Thyroxine and Antithyroids-** Thyroxine\*, Methimazole, Methyl thiouracil, Propylthiouracil.

**Diagnostic Agents-** Lophanoic Acid, Propyl iodone, Sulfbromophthalein-sodium, Indigotindisulfonate, Indigo Carmine, Evans blue, Congo Red, Fluorescein sodium.

**Anticonvulsants, cardiac glycosides, Antiarrhythmic, Antihypertensives & Vitamins.**

**Steroidal Drugs-** Betamethasone, Cortisone, Hydrocortisone, Prednisolone, Progesterone, Testosterone, Oestradiol, Nandrolone.

**Anti-Neoplastic Drugs-** Actinomycin, Azathioprine, Busulphan, Chloramubucil, Cisplatin, Cyclophosphamide, Daunorubicin Hydrochloride, Fluorouracil, Mercaptopurine, Methotrexate, Mytomycin.

#### **Books Recommended: (Latest editions)**

1. Pharmacopoeia of India.
2. British Pharmaceutical codex.
3. Martindale's Extra pharmacopoeia.

#### **PRACTICAL (75 hours)**

1. Systematic qualitative testing of organic drugs involving solubility determination, melting point and/or boiling point, detection of elements and functional groups (10 compounds).
2. Official identification tests for certain groups of drugs included in the I.P. like barbiturates, sulfonamides, Phenothiazines, Antibiotics etc.(8 compounds).
3. Preparation of three simple organic preparations.

## **2.3 PHARMACOLOGY & TOXICOLOGY**

### **THEORY (75 hours)**

#### **Introduction to pharmacology, scope of pharmacology.**

**Routes of administration of drugs,** their advantages and disadvantages. Various processes of absorption of drugs and the factors affecting them. Metabolism, distribution and excretion of drugs.

**General mechanism of drugs action** and their factors which modify drugs action. Pharmacological classification of drugs. The discussion of drugs should emphasize the following aspects:

#### **Drugs acting on the central Nervous system:**

General anaesthetics- adjunction to anaesthesia, intravenous anaesthetics.  
Analgesic antipyretics and non-steroidal  
Anti-inflammatory drugs- Narcotic analgesics.  
Antirheumatic and anti-gout remedies.  
Sedatives and Hypnotics, psychopharmacological agents, anticonvulsants, analeptics.  
Centrally acting muscle relaxants and anti parkinsonism agents.  
Local anesthetics.  
Drugs acting on autonomic nervous system.  
Cholinergic drugs, Anticholinergic drugs, anticholinesterase drugs.  
Adrenergic drugs and adrenergic receptor blockers.  
Neurone blockers and ganglion blockers.  
Neuromuscular blockers, used in myasthenia gravis.  
Drugs acting on eye: Mydriatics, drugs used in glaucoma.

#### **Drugs acting on respiratory system**

Respiratory stimulants, Bronchodilators, Nasal decongestants, Expectorants and Antitussive agents.

**Autocoids:** physiological role of histamine and serotonin, Histamine and Antihistamines, prostaglandins.

#### **Cardio vascular drugs**

Cardiotonics, Antiarrhythmic agents, Anti-anginal agents, Antihypertensive agents, peripheral Vasodilators and drugs used in atherosclerosis.

Drugs acting on the blood and blood forming organs. Haematinics, coagulants and anticoagulants, Haemostatic , Blood substitutes and plasma expanders.

**Drugs affecting renal function-** Diuretics and anti-diuretics.

**Hormones and hormone antagonists-** Hypoglycemic agents, Anti--thyroid drugs, sex hormones and oral contraceptives , corticosteroids.

**Drugs acting on digestive system-**carminatives, digest ants, Bitters, Antacids and drugs used in peptic ulcer, purgatives ,and laxatives, Antidiarrhoeals, Emetics, Anti-emetics, Antispasmodics.

#### **Chemotherapy of microbial diseases:**

Urinary antiseptics, sulphonamides, penicillin, streptomycin, Tetracyclines and other antibiotics. Anti-tubercular agents, Antifungal agents, antiviral drugs, anti-leprotic drugs.

Chemotherapy of protozoal diseases, Anthelmintic drugs.

Chemotherapy of cancer.

**Disinfectants and antiseptics.**

## **PHARMACOLOGY**

### **PRACTICAL (50 hours)**

1. The first six of the following experiments will be done by the students while
2. the remaining will be demonstrated by the teacher.
3. Effect of potassium and calcium ions, acetylcholine and adrenaline on frog's heart.
4. Effect of acetyl choline on rectus abdomens muscle of frog and guinea pig ileum.
5. Effect of spasmogens and relaxants on rabbits intestine.
6. Effect of local anaesthetics on rabbit cornea.
7. Effect of mydriatics and miotics on rabbit's eye.
8. To study the action of strychnine on frog.
9. Effect of digitalis on frog's heart.
10. Effect of hypnotics in mice.



11. Effect of convulsants and anticonvulsant in mice or rats.
12. Test for pyrogens.
13. Taming and hypnosis potentiating effect of chlorpromazine in mice/rats.
14. Effect of diphenhydramine in experimentally produced asthma in guinea pigs.

## **2.4 PHARMACEUTICAL JURISPRUDENCE**

### **THEORY (50 hours)**

**Origin and nature of pharmaceutical legislation in India**, its scope and objectives. Evolution of the "Concept of pharmacy" as an integral part of the Health care system.

**Principles and significance of professional Ethics**. Critical study of the code of pharmaceutical Ethics drafted by pharmacy council of India.

**Pharmacy Act,1948**-The General study of the pharmacy Act with special reference to Education Regulations ,Working of state and central councils, constitution of these councils and functions, Registration procedures under the Act.

**The Drugs and Cosmetics Act,1940**-General study of the Drugs and cosmetics Act and the Rules there under. Definitions and salient features related to retail and whole sale distribution of drugs. The powers of Inspectors, the sampling procedures and the procedure and formalities in obtaining licenses under the rule. Facilities to be provided for running a pharmacy effectively. General study of the schedules with special reference to schedules C,C1,F,G,J,H,P and X and salient features of labeling and storage conditions of drugs.

**The Drugs and Magic Remedies (objectionable Advertisement)Act, 1954**-General study of the Act, objectives , special reference to be laid on Advertisements, magic remedies and objections<sup>1</sup> and permitted advertisements -diseases which cannot be claimed to be cured.

**Narcotic Drugs and psychotropic substances Act,1985**-A brief study of the act with special reference to its objectives, offences and punishment.

Brief introduction to the study of the following acts:

**Latest Drugs (price control) order in force.**

**Poisons Act 1919(as amended to date)**

**Medicinal and Toilet preparations (excise Duties) Act, 1955 (as amended to date).**

**Medical Termination of Pregnancy Act, 1971(as amended to date).**

**Books recommended:(Latest editions)**

Bare Acts of the said laws published by Government.

## 2.5 DRUG STORE AND BUSINESS MANAGEMENT

### THEORY (75 hours)

#### Part I Commerce (50 hours)

**Introduction**-Trade, Industry and commerce, Functions and subdivision of commerce, Introduction to Elements for Economics and Management. Forms of Business Organizations. Channels of Distribution.

**Drug House Management**-selection of site, space Lay-out and legal requirements. Importance and objectives of purchasing, selection of suppliers, credit information, tenders, contracts and price determination and legal requirements thereto.Codification, handling of drug stores and other hospital supplies. Inventory Control-objects and importance, modern techniques like ABC,VED analysis, the lead time, inventory carrying cost, safety stock, minimum and maximum stock levels, economic order quantity, scrap and surplus disposal.

**Sales** promotion, Market Research, Salesmanship, qualities of a salesman, Advertising and Window Display.

**Recruitment, training**, evaluation and compensation of the pharmacist.

**Banking and Finance**-Service and functions of bank, Finance planning and sources of finance.

#### Part II Accountancy (25 hours)

**Introduction to the accounting** concepts and conventions. Double entry Book Keeping, Different kinds of accounts. Cash Book. General Ledger and Trial Balance. Profit and Loss Account and Balance Sheet. Simple techniques of analyzing financial statements. Introduction to Budgeting.

**Books Recommended: (Latest editions)**

## 2.6 HOSPITAL AND CLINICAL PHARMACY

### THEORY (75 hours)

#### Part-I: Hospital Pharmacy:

**Hospital**-Definition, Function, classifications based on various criteria, organization, Management and health delivery system in India.

**Hospital Pharmacy:** Definition Functions and objectives of Hospital pharmaceutical services. Location, Layout, Flow chart of materials and men.

Personnel and facilities requirements including equipments based on individual and basic needs. Requirements and abilities required for Hospital pharmacists.

**Drug Distribution system in Hospitals.** Out-patient service,

In-patient services- types of services detailed discussion of unit Dose system, Floor ward stock system, satellite pharmacy services, central sterile services, Bed side pharmacy.

**Manufacturing:** Economical considerations, estimation of demand.

**Sterile manufacture**-Large and small volume parenterals, facilities, requirements, layout production planning , man-power requirements.

**Non-sterile manufacture**-Liquid orals, externals, Bulk concentrates. Procurement of stores and testing of raw materials.

Nomenclature and uses of surgical instruments and Hospital Equipments and health accessories.

**P.T.C.(pharmacy Therapeutic Committee)**

**Hospital Formulary system** and their organization, functioning, composition.

**Drug Information service** and Drug Information Bulletin.

**Surgical dressing** like cotton, gauze, bandages and adhesive tapes including their pharmacopoeial tests for quality. Other hospital supply eg. I.V.sets, B.G. sets, Ryals tubes, Catheters, Syringes etc

**Application of computers** in maintenance of records, inventory control, medication monitoring, drug information and data storage and retrieval in hospital retail pharmacy establishment.

## **Part II: Clinical Pharmacy:**

**Introduction to Clinical pharmacy practice**- Definition, scope.

**Modern dispensing aspects**- Pharmacists and patient counseling and advice for the use of common drugs, medication history.

**Common daily terminology used in the practice of Medicine.**

**Disease, manifestation and patho-physiology** including salient symptoms to understand the disease like Tuberculosis, Hepatitis, Rheumatoid Arthritis, Cardio-vascular diseases, Epilepsy, Diabetes, Peptic Ulcer, Hypertension.

**Physiological parameters with their significance.**

**Drug Interactions:** Definition and introduction. Mechanism of Drug Interaction. Drug-drug interaction with reference to analgesics, diuretics, cardiovascular drugs, Gastro-intestinal agents. Vitamins and Hypoglycemic agents. Drug-food interaction.

**Adverse Drug Reaction:** Definition and significance. Drug-Induced diseases and Teratogenicity.

**Drugs in Clinical Toxicity**- Introduction, general treatment of poisoning, systemic antidotes, Treatment of insecticide poisoning, heavy metal poison, Narcotic drugs, Barbiturate, Organo-phosphorus poisons.

**Drug dependences**, drug abuse, addictive drugs and their treatment, complications.

**Bio-availability of drugs**, including factors affecting it.

**Books Recommended:(Latest editions)**

1. Remington's pharmaceutical sciences.
2. Testing of raw materials used in (1).
3. Evaluation of surgical dressings.
4. Sterilization of surgical instruments, glassware and other hospital supplies.
5. Handling and use of data processing equipments.