First Year :

S.No.	Name of Subject	No. of hours of Theory	No. of hours of Practical	No. of hours of Tutorial
(1)	**(2)**	**(3)**	**(4)**	**(5)**
1.1	Human Anatomy and Physiology	3	3	1
1.2	Pharmaceutics	2	3	1
1.3	Medicinal Biochemistry	3	3	1
1.4	Pharmaceutical Organic Chemistry	3	3	1
1.5	Pharmaceutical Inorganic Chemistry	2	3	1
1.6	Remedial Mathematics/ Biology	3	3*	1
	Total hours	**16**	**18**	**6 = (40)**

* For Biology

APPENDIX-A

(See regulation 8)

PHARM.D. SYLLABUS

First Year

1.1 HUMAN ANATOMY & PHYSIOLOGY (THEORY)

Theory : 3 Hrs. /Week

1. **Scope and Objectives:** This course is designed to impart a fundamental knowledge on the structure and functions of the human body. It also helps in understanding both homeostasis mechanisms and homeostatic imbalances of various body systems. Since a medicament, which is produced by pharmacist, is used to correct the deviations in human body, it enhances the understanding of how the drugs act on the various body systems in correcting the disease state of the organs.

2. **Upon completion of the course the student shall be able to:**
   a. describe the structure (gross and histology) and functions of various organs of the human body;
   b. describe the various homeostatic mechanisms and their imbalances of various systems;
   c. identify the various tissues and organs of the different systems of the human body;
   d. perform the hematological tests and also record blood pressure, heart rate, pulse and Respiratory volumes;
   e. appreciate coordinated working pattern of different organs of each system; and
   f. appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body

3. **Course materials:**

   Text books
   a. Tortora Gerard J. and Nicholas, P. Principles of anatomy and physiology Publisher Harpercollins college New York.
   b. Wilson, K.J.W. Ross and Wilson's foundations of anatomy and physiology. Publisher: Churchill Livingstone, Edinburg.

   Reference books
   a. Guyton arthur, C. *Physiology of human body*. Publisher: Holtsaunders.
   b. Chatterjee,C.C. *Human physiology*. Volume 1&11. Publisher: medical allied agency, Calcutta.
   c. Peter L. Williams, Roger Warwick, Mary Dyson and Lawrence, H.
   d. *Gray's anatomy.* Publisher:Churchill Livingstone, London.

4. Lecture wise program :

Topics

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

2 Structure of cell – its components and their functions.

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

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

5 Haemopoetic System
a) Composition and functions of blood
b) Haemopoesis and disorders of blood components (definition of disorder)
c) Blood groups
d) Clotting factors and mechanism
e) Platelets and disorders of coagulation

6 Lymph
a) Lymph and lymphatic system, composition, formation and circulation.
b) Spleen: structure and functions, Disorders
c) Disorders of lymphatic system (definition only)

7 Cardiovascular system
a) Anatomy and functions of heart
b) Blood vessels and circulation (Pulmonary, coronary and systemic circulation)
c) Electrocardiogram (ECG)
d) Cardiac cycle and heart sounds
e) Blood pressure – its maintenance and regulation
f) Definition of the following disorders
Hypertension, Hypotension, Arteriosclerosis, Atherosclerosis, Angina, Myocardial infarction, Congestive heart failure, Cardiac arrhythmias

8 Respiratory system
a) Anatomy of respiratory organs and functions
b) Mechanism / physiology of respiration and regulation of respiration
c) Transport of respiratory gases
d) Respiratory volumes and capacities, and Definition of: Hypoxia, Asphyxia, Dybarism, Oxygen therapy and resuscitation.

9 Digestive system
a) Anatomy and physiology of GIT
b) Anatomy and functions of accessory glands of GIT
c) Digestion and absorption
d) Disorders of GIT (definitions only)

10 Nervous system
a) Definition and classification of nervous system
b) Anatomy, physiology and functional areas of cerebrum
c) Anatomy and physiology of cerebellum
d) Anatomy and physiology of mid brain
e) Thalamus, hypothalamus and Basal Ganglia
f) Spinal card: Structure & reflexes – mono-poly-planter
g) Cranial nerves – names and functions
h) ANS – Anatomy & functions of sympathetic & parasympathetic N.S.

11 Urinary system
a) Anatomy and physiology of urinary system
b) Formation of urine
c) Renin Angiotensin system – Juxtaglomerular apparatus - acid base Balance
d) Clearance tests and micturition

12 Endocrine system
a) Pituitary gland
b) Adrenal gland
c) Thyroid and Parathyroid glands
d) Pancreas and gonads

13 Reproductive system
a) Male and female reproductive system
b) Their hormones – Physiology of menstruation
c) Spermatogenesis & Oogenesis
d) Sex determination (genetic basis)
e) Pregnancy and maintenance and parturition
f) Contraceptive devices

14 Sense organs
a) Eye
b) Ear
c) Skin
d) Tongue & Nose

15 Skeletal muscles
a) Histology
b) Physiology of Muscle contraction
c) Physiological properties of skeletal muscle and their disorders (definitions)

16 Sports physiology
a) Muscles in exercise, Effect of athletic training on muscles and muscle performance,
b) Respiration in exercise, CVS in exercise, Body heat in exercise, Body fluids and salts in exercise,
c) Drugs and athletics

1.1 HUMAN ANATOMY & PHYSIOLOGY (PRACTICAL)

Practical : 3 Hrs./Week

General Requirements: Dissection box, Laboratory Napkin, muslin cloth, record, Observation book(100pages), Stationary items, Blood lancet.

Course materials:

Text books

Goyal, R. K, Natvar M.P, and Shah S.A, Practical anatomy, physiology and biochemistry, latest edition, Publisher: B.S Shah Prakashan, Ahmedabad.

Reference books

Ranade VG, Text book of practical physiology, Latest edition, Publisher: PVG, Pune
Anderson Experimental Physiology, Latest edition, Publisher: NA

List of Experiments:

1. Study of tissues of human body
   (a) Epithelial tissue.
   (b) Muscular tissue.
2. Study of tissues of human body
   (a) Connective tissue.
   (b) Nervous tissue.
3. Study of appliances used in hematological experiments.
4. Determination of W.B.C. count of blood.
5. Determination of R.B.C. count of blood.
6. Determination of differential count of blood.
7. Determination of
   (a) Erythrocyte Sedimentation Rate.
   (b) Hemoglobin content of Blood.
   (c) Bleeding time & Clotting time.
8. Determination of
   (a) Blood Pressure.
   (b) Blood group.
9. Study of various systems with the help of charts, models & specimens
   (a) Skeleton system part I-axial skeleton.
   (b) Skeleton system part II- appendicular skeleton.
   (c) Cardiovascular system.
   (d) Respiratory system.

(e) Digestive system.
(f) Urinary system.
(g) Nervous system.
(h) Special senses.
(i) Reproductive system.

10. Study of different family planning appliances.
11. To perform pregnancy diagnosis test.
12. Study of appliances used in experimental physiology.
13. To record simple muscle curve using gastroenemius sciatic nerve preparation.
14. To record simple summation curve using gastroenemius sciatic nerve preparation.
15. To record simple effect of temperature using gastroenemius sciatic nerve preparation.
16. To record simple effect of load & after load using gastroenemius sciatic nerve preparation.
17. To record simple fatigue curve using gastroenemius sciatic nerve preparation.

Scheme of Practical Examination:

	Sessionals	**Annual**
Identification	04	10
Synopsis	04	10
Major Experiment	07	20
Minor Experiment	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03hrs**	**04hrs**

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity, promptness, viva-voce and record maintenance).

1.2 PHARMACEUTICS (THEORY)

Theory : 2 Hrs. /Week

1. **Scope and objectives:** This course is designed to impart a fundamental knowledge on the art and science of formulating different dosage forms. It prepares the students for most basics of the applied field of pharmacy.

2. **Upon the completion of the course the student should be able to:**
   a. know the formulation aspects of different dosage forms;
   b. do different pharmaceutical caluculation involved in formulation;
   c. formulate different types of dosage forms; and
   d. appreciate the importance of good formulation for effectiveness.

3. **Course materials:**

   Text books
   a. Cooper and Gunns Dispensing for pharmacy students.
   b. A text book Professional Pharmacy by N.K.Jain and S.N.Sharma.

   Reference books
   a. Introduction to Pharmaceutical dosage forms by Howard C. Ansel.
   b. Remington's Pharmaceutical Sciences.
   c. Register of General Pharmacy by Cooper and Gunn.
   d. General Pharmacy by M.L.Schroff.

4. **Lecture wise programme:**

   Topics

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

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

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

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

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

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

7 Biphasic dosage forms: Suspensions and emulsions, Definition, advantages and disadvantages, classification, test for the type of emulsion, formulation, stability and evaluation.
8 Suppositories and pessaries: Definition, advantages and disadvantages, types of base, method of preparation, Displacement value and evaluation.
9 Galenicals: Definition, equipment for different extraction processes like infusion, Decoction, Maceration and Percolation, methods of preparation of spirits, tinctures and extracts.
10 Pharmaceutical calculations.
11 Surgical aids: Surgical dressings, absorbable gelatin sponge, sutures, ligatures and medicated bandages.
12 Incompatibilities: Introduction, classification and methods to overcome the incompatibilities.

1.2 PHARMACEUTICS (PRACTICAL)

Practical : 3 Hrs./Week

List of Experiments:

1. **Syrups**
   a. Simple Syrup I.P
   b. Syrup of Ephedrine Hcl NF
   c. Syrup Vasaka IP
   d. Syrup of ferrous Phosphate IP
   e. Orange Syrup
2. **Elixir**
   a. Piperizine citrate elixir BP
   b. Cascara elixir BPC
   c. Paracetamol elixir BPC
3. **Linctus**
   a. Simple Linctus BPC
   b. Pediatric simple Linctus BPC
4. **Solutions**
   a. Solution of cresol with soap IP
   b. Strong solution of ferric chloride BPC
   c. Aqueous Iodine Solution IP
   d. Strong solution of Iodine IP
   e. Strong solution of ammonium acetate IP

5. **Liniments**
   a. Liniment of turpentine IP*
   b. Liniment of camphor IP
6. **Suspensions***
   a. Calamine lotion
   b. Magnesium Hydroxide mixture BP
7. **Emulsions***
   a. Cod liver oil emulsion
   b. Liquid paraffin emulsion
8. **Powders**♣
   a. Eutectic powder
   b. Explosive powder
   c. Dusting powder
   d. Insufflations
9. **Suppositories**♣
   a. Boric acid suppositories
   b. Chloral suppositories
10. **Incompatibilities**
    a. Mixtures with Physical
    b. Chemical & Therapeutic incompatibilities

***** colourless bottles required for dispensing **♣** Paper envelope (white), butter paper and white paper required for dispensing.

Scheme of Practical Examination:

	Sessionals	**Annual**
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03hrs**	**04hrs**

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity, promptness, viva-voce and record maintenance).

1.3 MEDICINAL BIOCHEMISTRY

Theory: 3 Hrs. /Week

1. **Scope of the Subject:** Applied biochemistry deals with complete understanding of the molecular level of the chemical process associated with living cells. Clinical chemistry deals with the study of chemical aspects of human life in health and illness and the application of chemical laboratory methods to diagnosis, control of treatment, and prevention of diseases.
2. **Objectives of the Subject** (Know, do, appreciate): The objective of the present course is providing biochemical facts and the principles to the students of pharmacy. Upon completion of the subject student shall be able to –
   a. understand the catalytic activity of enzymes and importance of isoenzymes in diagnosis of diseases;
   b. know the metabolic process of biomolecules in health and illness (metabolic disorders);
   c. understand the genetic organization of mammalian genome; protein synthesis; replication; mutation and repair mechanism;
   d. know the biochemical principles of organ function tests of kidney, liver and endocrine gland; and
   e. do the qualitative analysis and determination of biomolecules in the body fluids.

Text books (Theory)

a. Harper's Illustrated biochemistry – Rodwell, et. Al., 31st edition 2018. Mc Graw Hill Education Lange
b. Text book of biochemistry – Satyanarayana. 7th Edition 2025. CBS publishers and Distribuitors
c. Text book of clinical chemistry: Interpretation and Techniques- Alex kaplan &Laverve L.Szabo Second edition 1983. Lippincott Williams and Wilkins

Reference books (Theory)

a. Lehninger's Principles of biochemistry – 8th Edition 2021. **W.H.Freeman & Co Ltd**
b. Text book of biochemistry – Ramarao. 11th edition. 2011
c. An introduction to Practical Biochemistry-David T.Plummer. Third edition, 2017. **McGraw Hill Education**
d. Laboratory Manual and Practical Biochemistry-Pattabhiraman. 4th edition. 2015. **All India Publishers & Distributors**

3. Lecture wise programme:

Topics

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

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

2.1 Introduction to carbohydrates, Proteins, lipids and Nucleic acids

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

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

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

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

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

8 The Kidney Function Tests: Role of kidney; Laboratory tests for normal function includes
a) Urine analysis (macroscopic and physical examination, quantitative and semiquantitative tests.)
b) Test for NPN constituents. (Creatinine /urea clearance, determination of blood and urine creatinine, urea and uric acid)
c) Urine concentration test d) Urinary tract calculi. (stones)
9 Liver Function Tests: Physiological role of liver, metabolic, storage, excretory, protective, circulatory functions and function in blood coagulation.
a) Test for hepatic dysfunction-Bile pigments metabolism.
b) Test for hepatic function test- Serum bilirubin, urine bilirubin, and urine urobilinogen.
c) Dye tests of excretory function.
d) Tests based upon abnormalities of serum proteins. Selected enzyme tests.

10 Lipid Profile Tests: Lipoproteins, composition, functions. Determination of serum lipids, total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides.

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

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

1.3 MEDICINAL BIOCHEMISTRY (PRACTICAL)

Practical: 3
Hrs./Week

Title of the Experiment

1 Qualitative analysis of normal constituents of urine.*
2 Qualitative analysis of abnormal constituents of urine.*
3 Quantitative estimation of urine sugar by Benedict's reagent method.**
4 Quantitative estimation of urine chlorides by Volhard's method.**
5 Quantitative estimation of urine creatinine by Jaffe's method.**
6 Quantitative estimation of urine calcium by precipitation method.**
7 Quantitative estimation of serum cholesterol by Libermann Burchard's method.**
8 Quantitative estimation of blood creatinine.**
9 Estimation of AST in serum.**
10 Estimation of ALT in serum.**
11 Estimation of Urea in Serum.**
12 Estimation of Proteins in Serum.**
13 Determination of serum bilirubin**
14 Determination of Glucose by means of Glucoseoxidase.**
15 Enzymatic hydrolysis of Glycogen/Starch by Amylases.**
16 Study of factors affecting Enzyme activity. (pH & Temp.)**
17 Preparation of standard buffer solutions and its pH measurements (any two)*
18 Experiment on lipid profile tests**
19 Determination of sodium, calcium and potassium in serum.**

** indicate major experiments & * indicate minor experiments

Assignments:

Format of the assignment

1. Minimum & Maximum number of pages.
2. It shall be computer draft copy.
3. Reference(s) shall be included at the end.
4. Name and signature of the student.
5. Assignment can be a combined presentation at the end of the academic year.
6. Time allocated for presentation may be 8+2 Min.

Scheme of Practical Examination:

	Sessionals	**Annual**
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03hrs**	**04hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity, promptness, viva-voce and record maintenance).

1.4 PHARMACEUTICAL ORGANIC CHEMISTRY (THEORY)

Theory : 3 Hrs. /Week

1. Scope and objectives: This course is designed to impart a very good knowledge about

a. IUPAC/Common system of nomenclature of simple organic compounds belonging to different classes of organic compounds;

b. Some important physical properties of organic compounds;

c. Free radical/ nucleophyllic [alkyl/ acyl/ aryl] /electrophyllic substitution, free radical/ nucleophyllic / electrophyllic addition, elimination, oxidation and reduction reactions with mechanism, orientation of the reaction, order of reactivity, stability of compounds;

d. Some named organic reactions with mechanisms; and

e. Methods of preparation, test for purity, principle involved in the assay, important medicinal uses of some important organic compounds.

2. Course materials:

Text books

1. Organic Chemistry by Morrison and Boyd. 6 th Edition, 2009, Pearson.
2. Organic Chemistry by Mehta and Mehta. 2 nd Edition, 2017, PHI Learning.
3. Organic Chemistry by I.L. Finar, Volume-I. 6 th Edition, 1995, ELBS with Longman.
4. Organic Chemistry by I.L. Finar, Volume-II. 5 th Edition, 2012, Pearson.
5. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl. 12 th Revised Edition, 2011, S. Chand & Company Limited
6. Vogel's text book of Practical Organic Chemistry. 5 th Edition, 2006, Pearson.
7. Reaction and reaction mechanism by Ahluwaliah. 4 th Edition, 2018, Narosa Publishing House.

Reference books

a. Organic chemistry – J.M.Cram and D.J.Cram. International Student Edition, 1964, McGraw-Hill Inc.,US

b. Understanding Organic chemistry- William H. Brown, Kevin Ford & Christopher Foote, 2009, Cengage Learning.

3. Lecture wise programme :

Topics

1. Structures and Physical properties:

a. Polarity of bonds, polarity of molecules, M.P, Inter molecular forces, B.P, Solubility, non ionic solutes and ionic solutes, protic and aprotic Solvents, ion pairs,

b. Acids and bases, Lowry bronsted and Lewis theories

c. Isomerism

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

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

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

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

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

7 .Electrophillic and free radicals addition: Reactions at carbon-carbon, double bond, electrophile, hydrogenation, heat of hydrogenation and stability of alkenes, markownikoff rule, addition of hydrogen halides, addition of hydrogen bromides, peroxide effect, electrophillic addition, mechanism, rearrangement, absence of hydrogen exchange, orientation and reactivity, addition of halogen, mechanism, halohydin formation, mechanism of free radicals additon, mechanism of peroxide initiated addition of hydrogen bromide, orientation of free addition, additions of carbene to alkene, cyclo addition reactions.

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

9. Theory of resonance: Allyl radical as a resonance hybrid, stability, orbital picture, resonance stabilisation of allyl radicals, hyper conjugation, allyl cation as a resonance hybrid, nucleophyllic substitution in allylic substrate, SN1 reactivity, allylic rearrangement, resonance stabilisation of allyl cation, hyper conjugation, nucleophilic substitution in allylic substrate, SN2 nucleophilic substituion in vinylic substrate, vinylic cation, stability of conjugated dienes, resonance in

alkenes, hyper conjugation, ease of formation of conjugated dienes, orientation of elimination, electrophilic addition to conjugated dienes, 1,4- addition, 1,2-versus 1,4-addition, rate versus equilibrium, orientation and reactivity of free radical addition to conjugated dienes.

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

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

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

13. **Hoffman rearrangement**: Migration to electron deficient nitrogen, Sandmeyer's reaction, basicity of amines, diazotisation and coupling, acidity of phenols, Williamson synthesis, Fries rearrangement, Kolbe reaction, Reimer tieman's reactions.
14. **Nucleophilic aromatic substitution**: Bimolecular displacement mechanisms, orientation, comparison of aliphatic nucleophilic substitution with that of aromatic.
15. Oxidation reduction reaction.
16. ***Stereo isomerism:***

Optical isomerism – Optical activity, enantiomerism, diastereoisomerism, meso compounds

Elements of symmetry, chiral and achiral molecules, sequence rules, RS system of nomenclature of optical isomers Reactions of chiral molecules Racemic modification and resolution of racemic mixture.

1.3 PHARMACEUTICAL ORGANIC CHEMISTRY (PRACTICAL)

Practical : 3 Hrs./Week I.

Introduction to the various laboratory techniques through demonstration involving synthesis of the following compounds (at least 8 compounds to be synthesised):

1. Acetanilde / aspirin (Acetylation)
2. Benzanilide / Phenyl benzoate (Benzoylation)
3. P-bromo acetanilide / 2,4,6 – tribromo aniline (Bromination)
4. Dibenzylidene acetone (Condensation)
5. 1-Phenylazo-2-napthol (Diazotisation and coupling)
6. Benzoic acid / salicylic acid (Hydrolysis of ester)
7. M-dinitro benzene (Nitration)
8. 9, 10 – Antharaquinone (Oxidation of anthracene) / preparation of benzoic acid from toluene or benzaldehyde
9. M-phenylene diamine (Reduction of M-dinitrobenzene) / Aniline from nitrobenzene
10. Benzophenone oxime
11. Nitration of salicylic acid
12. Preparation of picric acid
13. Preparation of O-chlorobenzoic acid from O-chlorotolune
14. Preparation of cyclohexanone from cyclohexanol .

II Identification of organic compounds belonging to the following classes by :

Systematic qualitative organic analysis including preparation of derivatives Phenols, amides, carbohydrates, amines, carboxylic acids, aldehyde and ketones, Alcohols, esters, hydrocarbons, anilides, nitrocompounds.

III.Introduction to the use of stereo models:

Methane, Ethane, Ethylene, Acetylene, Cis alkene, Trans alkene, inversion of configuration. **Scheme of Practical Examination:**

	Sessionals	**Annual Synopsis**
synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
viva	02	15
Max Marks	**20**	**70**
Duration	**03hrs**	**04hrs**

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity, promptness, viva-voce and record maintenance)

1.5 PHARMACEUTICAL INORGANIC CHEMISTRY (THEORY)

Theory : 2 Hrs. /Week

1. **Scope and objectives:** This course mainly deals with fundamentals of Analytical chemistry and also the study of inorganic pharmaceuticals regarding their monographs and also the course deals with basic knowledge of analysis of various pharmaceuticals.
2. **Upon completion of the course student shall be able to:**
   a. understand the principles and procedures of analysis of drugs and also regarding the application of inorganic pharmaceuticals;
   b. know the analysis of the inorganic pharmaceuticals their applications; and
   c. appreciate the importance of inorganic pharmaceuticals in preventing and curing the disease.
3. **Course materials:**

Text books

a. G.R. Chatwal, Pharmaceutical chemistry – inorganic, Vol.I, 5 th revised edition, 2024, Himalaya publishing house, New Delhi.
b. Surendra N.Pandeya, A text book of inorganic medicinal chemistry, 2 nd edition, 2006, SG Publisher, Varanasi.
c. A.H. Beckett &; J.B. Stenlake;s, Practical Pharmaceutical Chemistry Vol I & II, 4 th edition, 2005, CBS Publisher and distributers, New Delhi.
d. A.I. Vogel, Text Book of Quantitative Inorganic analysis 4 th Impression Edition, 2011, Pearson, Delhi.
e. Bentley and Driver's Textbook of Pharmaceutical Chemistry 8 th Edition, 2004, Oxford University Press, New Delhi.

Reference books

a. Pharmaceutical Inorganic chemistry by Dr.B.G.Nagavi
b. Analytical chemistry principles by John H. Kennedy I.P.1985 and 1996, Govt. of India, Ministry of health
c. Indian Pharmacopoeia, 8 th Edition, 2018, The Indian Pharmacopoeia Commission, Ghaziabad.

4. **Lecture wise programme:**

UNIT-I:

ERRORS: Errors in quantitative analysis, classification of errors, concept of accuracy and precision, treatment of analytical results.

VOLUMETRIC ANALYSIS: Principle of volumetric analysis, different methods for expressing concentrations of solutions, primary secondary standard.

LIMIT TESTS: Definition, importance, general procedure for limit test for chlorides, sulphates,iron,arsenic,lead and heavy metals.

ESSENTIAL TRACE ELEMENTS: Cu, Zn, Mn, Mo, Sc, Cr, iodine.

UNIT-II:

ACID-BASE TITRATIONS: Acid base concepts, relative strength of acids and bases, law of mass action, common ion effect, ionic product of water, Henderson hasselbalch equation, buffer

solutions, theory of indicators, neutralization curves, choice of indicators, mixed and universal indicators.

REDOX-TITRATIONS: Concepts of oxidation reduction reactions, redox reactions, theory of redox titrations, redox indicators, iodometry and iodimetry, titrations involving cerric sulphate, potassium iodate, potassium bromate, potassium permanganate, titanous chloride.

NON-AQUEOUS TITRATIONS: Theoretical basis, types of solvents, preparations and standardizations of titrant solutions, titration of weak acid, weak bases and indicators. Standardisation of perchloric acid, lithium and sodium methoxide, tetra butyl ammonium hydroxide.

COMPLEXOMETRIC TITRATIONS: Introduction, principle, types of titrations, end point detection.

THEORY OF INDICATORS.

UNIT-III:

PRECIPITATION TITRATIONS: Introduction, types of precipitation titrations, end point detection.

GRAVIMETRY: Basic concepts, precipitation techniques, co-precipitation, post precipitation, various steps involved in gravimetric analysis, pharmaceutical applications.

Method of preparation, assay, storage conditions and uses of inorganic compounds listed in I.P belonging to the following categories.

ACIDIFIERS: Dilute hydrochloric acid, Sodium phosphate, Ammonium chloride.

ANTACIDS: Classification, qualities of an ideal antacid, side effects, advantages, combination therapy, acid neutralizing capacity, sodium bicarbonate, potassium citrate, aluminium hydroxide gel, dried aluminium hydroxide gel, magnesium hydroxide, light and heavy magnesium trisilicate, light and heavy magnesium carbonate, calcium carbonate. Magaldrate and bismuth carbonate.

CATHARTICS: Magnesium hydroxide, Magnesium sulphate, magnesium carbonate and sodium phosphate.

UNIT-IV:

PHARMACEUTICAL AIDS: Sodium meta bisulphate, magnesium stearate, bentonite, sodium CMC, Aluminium sulphate, Zinc stearate.

ELECTROLYTE REPLENISHERS: Sodium chloride, Calcium chloride, Calcium gluconate, Sodium acetate, Sodium chloride injection, oral rehydration salt, potassium chloride.

ANTI-MICROBIALS: Hydrogen peroxide, Silver nitrate, Potassium permanganate.

DENTAL PRODUCTS: Fluorides, dibasic calcium phosphate.

IRON COMPOUNDS: Ferrous sulphate, Ferrous gluconate

UNIT-V:

MEDICINAL GASES: Preparation and uses of the following oxygen, carbon dioxide, helium, nitrogen and nitrous oxide.

RADIOPHARMACEUTICALS: Applications of radio pharmaceuticals, properties of radiation, barium sulphate.

MISCELLANEOUS COMPOUNDS: Sedative-Hypnotics:- KBr.

Anti-dotes:-Sodium nitrite, Sodium thiosulphate, Charcoal, Potassium iodide, Hypertonic solution.

1.5 PHARMACEUTICAL INORGANIC CHEMISTRY (PRACTICAL)

Practical : 3 Hrs./Week

1. **Limit test (6 exercises)**
   a. Limit test for chlorides
   b. Limit test for sulphates
   c. Limit test for iron
   d. Limit test for heavy metals
2. *Assays (10 exercises)*
   a. Ammonium chloride- Acid-base titration
   b. Ferrous sulphate, Zinc sulphate
   c. Copper sulpahte- Iodometry
   d. Calcilugluconate- Complexometry
   e. Hydrogen peroxide – Permanganometry
   f. Sodium benzoate – Nonaqueous titration
   g. Sodium chloride
   h. Assay of aluminium hydroxide
   i. Gravimetric estimation of barium as barium sulphate
   j. Assay of Magnesium hydroxide

3. *Estimation of mixture (Any twoe xercises)*
   a. Sodium hydroxide and sodium carbonate
   b. Boric acid and Borax
   c. Oxalic acid and sodium oxalate

4. *Test for identity (Any three exercises)*
   a. Sodium bicorbonate
   b. Barium sulphate
   c. Ferrous sulphate
   d. Potassium chloride

5. *Test for purity (Any two exercises)*
   a. Swelling power in Bentonite
   b. Acid neutralising capacity in aluminium hydroxide gel
   c. Ammonium salts in potash alum
   d. Adsorption power heavy Kaolin
   e. Presence of Iodates in KI

6. *Preparations (Any two exercises)*
   a. Boric acids
   b. Potash alum
   c. Calcium lactate
   d. Magnesium suphate

1.6 REMIDIAL BIOLOGY

1. Scope and objectives: This is an introductory course in Biology, which gives detailed study of natural sources such as plant and animal origin. This subject has been introduces to the pharmacy course in order to make the student aware of various naturally occurring drugs and its history, sources, classification, distribution and the characters of the plants and animals. This subject gives basic foundation to Pharmacognosy.

2. Course materials:

Textbooks:

a. Gokhale SB; Textbook of Biology; Revised Edition; India; Nirali Prakashan; 2008.
b. Thulajappa DR, Seetaram K; A Textbook of Biology; 2nd Edition; India; Popular Book Depot; 2006.
c. Jordan E L & Verma PS.; Chordate Zoology; 14th Ed.; India; S. Chand & Company; 2014.

Reference Books:

a. Sreenivasa Naidu BV; A Textbook of Biology; Revised Edition; India; Vikas Publishing House; 2005.
b. Naidu BV, Murthy KV; A Textbook of Biology; Revised Edition; India; Vikas Publishing House; 2004.
c. Dutta AC; Botany for Degree Students; 16th Edition; India; Oxford University Press; 2003.
d. Ekambaranatha Ayyer M, Ananthakrishnan TN; Outlines of Zoology; 7th Edition; India; Viswanathan & Co; 1985.
e. Gokhale SB, Kokate CK; A Manual for Pharmaceutical Biology Practical; 4th Edition; India; Nirali
Prakashan; 2008.

3. Lecture wise programme :

Topic

PART – A:

01 Introduction
02 General organization of plants and its inclusions
03 Plant tissues
04 Plant kingdom and its classification
05 Morphology of plants
06 Root, Stem, Leaf and Its modifications
07 Inflorescence and Pollination of flowers
08 Morphology of fruits and seeds
09 Plant physiology
10 Taxonomy of Leguminosae, umbelliferae, Solanaceae, Lilliaceae, Zinziberaceae, Rubiaceae
11 Study of Fungi, Yeast, Penicillin and Bacteria

PART-B

1 Study of Animal cell
2 Study animal tissues
3 Study of frog systems – cardiovascular and nervous system
4 Study of Rat – External Features, Anatomy, and Significance as Experimental Animal (to be added)
5 Study of Rabbit – External Features, Anatomy, and Experimental Significance
6 Study of poisonous animals- snake, scorpion. Dog, monkey

BIOLOGY (PRACTICAL)

Practical : 3 Hrs./Week

Title:

1. Introduction of biology experiments
2. Study of cell wall constituents and cell inclusions
3. Study of Stem modifications
4. Study of Root modifications
5. Study of Leaf modifications
6. Identification of Fruits and seeds
7. T.S. of Senna, Cassia, Ephedra, Podophyllum.
8. Simple plant physiological experiments
9. Computer based tutorials

Scheme of Practical Examination :

	Sessionals	Annual
Identification	04	10
Synopsis	04	10
Major Experiment	07	20
Minor Experiment	03	15
Viva	02	15
Max Marks	20	70
Duration	03hrs	04hrs

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity, promptness, viva-voce and record maintenance.

1.6 REMEDIAL MATHEMATICS (THEORY)

Theory : 3 Hrs. /Week

1. Scope and objectives:

This is an introductory course in mathematics. This subjects deals with the introduction to matrices, determinants, trigonometry, analytical geometry, differential calculus, integral calculus, differential equations, laplace transform.

2. Upon completion of the course the student shall be able to : –

a. Know Trignometry, Analytical geometry, Matrices, Determinant, Integration, Differential equation, Laplace transform and their applications;

b. solve the problems of different types by applying theory; and

c. appreciate the important applications of mathematics in pharmacy.

3. Course materials:

Text books

a. Text book of Mathematics for Intermediate First year Paper- IA, Paper- IB. 2012, Telugu Academi, Hyderabad

b. Text book of Mathematics for Intermediate second year Paper-IIA, Paper - IIB. 2013, Telugu Academi, Hyderabad.

c. New intermediate mathematics, vol I for junior intermediate by s.chand and company.

d. New intermediate mathematics, vol II for junior intermediate by s.chand and company**.**

Reference books

a. Integral calculus By Shanthinarayan. 35th Edition. S Chand publishers

b. Engineering mathematics By B.S.Grewal. Standard edition 1965. Khanna Publishers.

c. Trigonometry Part-I By S.L.Loney. 6th Edition, 2016. **ARIHANT PUBLICATIONS INDIA LIMITED**

4. Lecture wise programme :

Unit – I

Logarithms: Introduction, definition, Theorems/properties of logarithms, problems. Common logarithms, characteristic and mantissa.

Analytical Geometry: Signs of co-ordinates, distance formula, midpoint, slope.

Straight Line:

Slope of a line, General equation of a straight line: slope-intercept form, intercept form, point-slope form and two-pointform, condition for parallel and perpendicularity of two lines.

Unit – II

Matrices and Determinants: Introduction, types of matrices, addition, subtraction and product of two matrices.Minors and co-factors, adjoint of a square matrix, inverse of matrix (2×2 and 3×3 order).Determinant– properties of determinant. Solution of system of linear equations by Cramer's Method and Matrix Inversion Method.

Unit – III

Trigonometry: Trigonometric ratios, compound angles: sin(A+B), sin(A−B), cos(A+B),
cos (A−B).

Unit – IV

Limits: standard limits.

Differentiation: Introduction, Derivative of algebraic function, Derivative of logarithm, exponential and trigonometric functions using first principles. Derivative of Sum, difference, product and quotient of functions.

Unit – V

Partial Differentiation: Introduction, partial derivatives of first order, second order. Euler's theorem on homogeneous function of two variables of degree n.

Unit – VI:

Calculus:

Indefinite integrals of standard functions, Integral of sum and difference of two functions.Integration by substitution, integration by parts.

Unit – VII:

Laplace Transform: Definition, Laplace transform of elementary functions. Linearity property: L[af(x) + bg(x)]. Problems, first shifting theorem, multiple of t^n.

Unit – VIII:

Circles: Equation of circle-standard form-centre and radius.Equation of circle passing through three points, Concyclic, passing through two points and centre lies on the line.

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