

Department of Higher Education, Government of M.P.

Under Graduate Annual System wise syllabus

As recommended by Central Board of Studies and approved by the Governor of M.P.

Session 2017-2018

Scheme of Marks

B.Sc. (Pharmaceutical Chemistry)

| Year | Paper | Paper Title | Max. marks | |
|----------|-------|---------------------------------------|------------|---------|
| | | | Regular | Private |
| I year | I | Pharmaceutical Organic Chemistry | 42.5/40 | 50 |
| | II | Inorganic and Pharmaceutical Analysis | 42.5/40 | 50 |
| | - | Practical | 50 | 50 |
| II Year | I | Medicinal Chemistry-I | 42.5/40 | 50 |
| | II | Chemistry of Natural Products | 42.5/40 | 50 |
| | - | Practical | 50 | 50 |
| III year | I | Medicinal Chemistry-II | 42.5/40 | 50 |
| | II | Instrumental Analysis | 42.5/40 | 50 |
| | - | Practical | 50 | 50 |

For regular students:

Max. Mark : 100

Internal evaluation : : 20 ¹⁰ marks (10 marks for tri monthly and 10 marks for six monthly CCF)

External Examination : 80 ⁸⁵ marks

Paper I : 40 ^{42.5} marks

Paper II : 40 ^{42.5} marks

Practical : 50 marks

Scheme of question paper for regular students

Objective type question : 5 mark (1 mark for each unit)
 Short answer question : 10 ¹⁵ marks (2 ³ marks for each unit)
 Long answer questions : 25 marks (5 marks for each unit)

Scheme of question paper for private students

Objective type question : 5 mark (1 mark for each unit)
 Short answer question : 15 marks (3 marks for each unit)
 Long answer questions : 30 marks (6 marks for each unit)

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B.Sc. (Pharmaceutical Chemistry)

First Year

Paper I

Pharmaceutical Organic Chemistry

Max. Marks : 42.5

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- Unit 1 Historical development of Pharmaceutical Chemistry. Atomic and molecular orbital, covalent bond, hybrid orbitals, intermolecular forces, bond dissociation energy (homolysis and heterolysis), polarity of bonds and molecules, structure and physical properties (melting point, boiling point, solubility), resonance, inductive effect, field effect, hyper conjugation, hydrogen bonding.
Acids and bases : Arrhenius concept, Bronsted-Lowry concept, strength of acids and bases, Lewis concept, pH, pKa, pKb values, buffers, buffers in pharmaceutical and biological systems, buffered isotonic solutions.
- Unit 2 Physicochemical properties and molecular constitution : Surface and interfacial tension, refractive index, optical rotation, dielectric constant, dipole moment, density, viscosity, molar refraction and parachor.
Stereo isomerism: Optical isomerism-Optical activity, enantiomerism, diastereoisomerism, meso compounds. Elements of symmetry, chiral and achiral molecules. DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers. Reactions of chiral molecules. Racemic modification and resolution of racemic mixture.
Geometrical isomerism: -Nomenclature of- geometrical isomers, methods of determination of configuration of geometrical isomers.
- Unit 3 Types of organic reactions, Mechanism of organic reactions: Curved arrow notations, drawings electron movement with arrows, half headed and double headed arrow, Electrophiles and nucleophiles, Reaction intermediates: Formation, structure, stability and reactivity of carbocation, carbanion, free radicals.
Nucleophilic aliphatic substitutions (SN^1 and SN^2 reactions): Mechanism, kinetics, order of reactivity and stereochemistry.
Elimination reactions (E^1 and E^2 reactions): Mechanism, kinetics, order of reactivity and stereochemistry.
- Unit 4 Classification of drugs on the basis of sources (Biological, Geographical, Marine, Minerals).
Theories of drug action: Biological defenses, chemical defenses, surface active agents, metabolic antagonism, enzyme neutralizers.

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Drug Receptor interactions and receptor theories.

Unit 5 Introduction to dosage forms: Classification and definitions, routes of drug administration. Aromatic waters, syrups, tinctures and infusions.

Introduction to medicinal system: Ayurvedic, Unani, Siddha, Homeopathic, Allopathic.

Weights and measures: Imperial and Metric system, Calculations involving percentage solutions, allegation, proof spirit and isotonic solutions based on freezing point and molecular weight.

Books Recommended

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry Vol. 1 by I.L. Finar
3. Physical Pharmacy by Alfred Martin
4. Text book of Pharmacognosy by Kokate, Purohit, Gokhale
5. Foye's Medicinal Chemistry
6. Text Book of Professional Pharmacy by Jain and Sharma
7. Practical Organic Chemistry by Arun Sethi
8. Practical Organic Chemistry by Garg and Saluja.
9. Practical Organic Chemistry by Jagdamba Singh.

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- Unit 1 Impurities in pharmaceutical substances: History of Pharmacopoeia, Sources and types of impurities, effect of impurities, permissible impurities in pharmaceutical substances, methods used to purify inorganic substances, Test of purity, Limit test principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals.
- Unit 2 Pharmaceutical analysis- Different techniques of analysis, Methods of expressing concentration, Primary and secondary standards, Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate. Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures
- Unit 3 Acid base titration: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves
 Non aqueous titration: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl
 Redox titrations : Concepts of oxidation and reduction and types of redox titrations (Principles and applications : Cerimetry, Iodimetry, Iodometry, Titration with potassium iodate)
- Unit 4 Precipitation titrations: Mohr's method, Volhard's, Modified , Volhard's, Fajans method, estimation of sodium chloride.
 Complexometric titration: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.
 Gravimetry: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate. Basic Principle, method and applications of diazotisation titration
- Unit 5 Preparation of following compounds and their uses : Alum, Aluminium hydroxide gel, Antimony potassium tartrate, aromatic spirit of ammonia, boric acid, potassium citrate, sodium benzoate, Milk of magnesia, magnesium carbonate, zinc oxide.

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Books Recommended

1. Inorganic Pharmaceutical Chemistry by Gundu Rao
2. Inorganic Pharmaceutical Chemistry by Chatwal.
3. Bentley and Driver's Textbook of Pharmaceutical Chemistry.
4. Pharmaceutical Analysis I and II, Kasture, Wadodkar.
5. Pharmaceutical Analysis by Kar
6. Analytical Chemistry, Chatwal.

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B.Sc. (Pharmaceutical Chemistry) First year –Practicals

Max. Marks : 50

1. Identification of elements and groups present in organic compounds.
2. Determination of solubility of benzoic acid over a range of temperatures.
3. Determination of surface tension, viscosity.
4. Preparation of aromatic waters, syrup, and tinctures.
5. Preparation of buffer solutions and measurement of pH.
6. Identification of the unknown compound from the literature using melting point/ boiling point.
7. Limit test of chloride, sulphate, iron and lead
8. Preparation of inorganic pharmaceuticals: Alum, Aluminium hydroxide gel, milk of magnesia, ferrous ammonium sulphate, antimony potassium tartarate
9. Preparation and standardization of sodium hydroxide, oxalic acid.
10. Assay of Ammonium chloride, borax, zinc oxide, sodium carbonate.
11. Assay of Copper sulphate by Iodometry.
12. Volumetric estimation of ferrous sulphate using oxalic acid, potassium permanganate and potassium dichromate.
13. Viva-voce

14. Practical Record

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B.Sc. (Pharmaceutical Chemistry)

Second Year

Paper I

Medicinal Chemistry-I

Max. Marks : 42.5

- Unit 1 Physicochemical properties in relation to biological action (Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.)
- Unit 2 General anesthetics : Classification, mechanism of action, synthesis of nitrous oxide, halothane, thiopental sodium and chloroform
Local anesthetics: Classification, mechanism of action, SAR, synthesis of procaine hydrochloride, benzocaine, lignocaine hydrochloride
- Unit 3 Hypnotic and sedative: Classification, mechanism of action, SAR of barbituric acid derivatives and synthesis of barbital, allobarbitol, hexobarbital. SAR of benzodiazepines and synthesis of diazepam, alprazolam, zolpidem.
Anti-convulsants: Classification, mechanism of action and synthesis of phenobarbital and phenytoin sodium.
- Unit 4 Analgesics and antipyretics: Classification, mechanism of action and SAR of morphine analogue, mechanism of action and SAR of salicylic acid, aryl alkanolic acid derivatives, synthesis of aspirin and paracetamol
Anti-histaminics: Classification, mechanism of action and SAR ethanolamine derivatives, synthesis of diphenhydramine hydrochloride, promethazine hydrochloride.
- Unit 5 Diuretics: Classification, mechanism of action and SAR. Synthesis and uses of hydrochlorothiazide, hydroflumethiazide, ethacrynic acid, furosemide, acetazolamide.
Antihypertensives : Classification, mechanism of action, SAR. Synthesis of captopril, propranolol hydrochloride.

Books Recommended

1. Foye's Medicinal Chemistry
2. Wilson and Gisvold's Text Book of Organic and Medicinal Chemistry
3. Medicinal Chemistry by A. Kar
4. Medicinal Chemistry by Sriram, and Yogeeswari
5. Medical Pharmacology, Tripathi
6. Pharmaceutical Chemistry, Chatwal

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- Unit 1 Heterocyclic compounds: Nomenclature, structure and reactions of imidazoles, oxazoles, pyrazoles, pyran, pyrimidine, purine, indole, isoquinolone.
- Unit 2 Carbohydrate: Classification, nomenclature, Monosaccharide: glucose and fructose and their reactions, cyclic structure of D-glucose, Disaccharides: Maltose, lactose and sucrose, polysaccharides: Starch, cellulose, dextran, glycogen, insulin.
- Fats : Fats, oils, waxes, fatty acids, physio-chemical properties, phospholipids, lecithenes, cephalins, plasmogens, glycolipids
- Unit 3 Amino acids : Classification, structure and stereochemistry of amino acids, properties of amino acids.
- Protein : Classification, properties of proteins, primary, secondary and tertiary structure of proteins.
- Nucleic acids: Introduction, structure of DNA and RNA.
- Unit 4 Alkaloids: Classification, general introduction, composition, chemistry and chemical classes, biosources, therapeutic uses and commercial applications of quinine, morphine, reserpine.
- Glycoloids: Classification, general introduction, composition, chemistry and chemical-classes, biosources, therapeutic uses and commercial applications of senna, aloes, bitter almond.
- Unit 5 Terpenes: Classification, isolation, general introduction, composition, chemistry and chemical classes, biosources, therapeutic uses and commercial applications of citral, carvone, menthol, thymol, camphor.
- Steroids: Isolation, nomenclature, chemistry of cholesterol, ergosterol, stigmasterol and cartosone.

Books Recommended

1. Heterocyclic chemistry, R.K. Bansal
2. Organic Chemistry by Morrison and Boyd
3. Heterocyclic Chemistry by T.L. Gilchrist
4. Chemistry of organic Natural products Vol. I and II by O.P. Agarwal.
5. Organic Chemistry Vol. II by Finar

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B.Sc. (Pharmaceutical Chemistry) Second -Practicals

Max. Marks : 50

1. Purification of pharmaceutical organic compounds: Decolourization, recrystallization, sublimation
2. Preparation of benzocaine and phenytoin.
3. Preparation of aspirin and paracetamol.
4. Determination of partition coefficient for any two drugs.
5. Determination of iodine value, acid value and saponification value.
6. Isolation of caffeine from tea and casein from milk.
7. Separation of amino acids by paper chromatography
8. Identification test of carbohydrate; proteins.
9. Separation of sugars by thin layer chromatography.
10. Separation of plant pigments by column chromatography
11. Synthesis of benzyl, thalimide, sulphanic acid
12. Viva-voce
13. Practical Record

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Unit 1 Adrenergic: Classification, mechanism of action and SAR of ethylamine analogue, synthesis of adrenaline, epinephrine, norepinephrine, ephedrine, dopamine.

Anticoagulants : Classification, mechanism of action, synthesis and uses of heparin, dicoumarol

Expectorants and anti-tussives: Classification, mechanism of action. Synthesis of acetylcysteine, guaifensin and noscapine.

Unit 2 Antibiotics: Historical background, Structure activity relationship, Chemical classification of β -Lactam antibiotics: Penicillin, Cephalosporins, Aminoglycosides: Streptomycin and neomycin, Tetracyclines: Tetracycline, Macrolide: Azithromycin; constitution and synthesis and uses of chloramphenicol.

Sulphonamide : Classification and mechanism of action, synthesis and uses of sulphacetamide, sulphaguanide, dapsone

Unit 3 Anti-malarial : Classification, mechanism of action, SAR of 4-amino quinolines, synthesis of chloroquine phosphate, amodiaquine hydrochloride, primaquine phosphate

Anti-tubercular drugs: Classification, mechanism, synthesis and uses of para amino salicylic acid, isoniazid, rifampicin.

Anti-amoebic : Classification, mechanism of action and synthesis and uses of metronidazole.

Unit 4 Anti-diabetic : Classification, Mechanism, synthesis and uses of metformin, sitagliptin, glimeperide.

Anti-neoplastic: Types of cancer, Classification, mechanism, synthesis and uses of 5-fluoro uracil, 6-mercaptopurine, thiotepa, busulphan.

Unit 5 Drug Design: Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity, relationship (QSAR) such as partition coefficient, Hammett's electronic parameter, Taft's steric parameter and Hansch analysis. Free Wilson analysis. Introduction to 3D-QSAR approaches.

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Books Recommended

1. Foye's Medicinal Chemistry
2. Wilson and Gisvold's Text Book of Organic and Medicinal Chemistry
3. Medicinal Chemistry by A. Kar
4. Medicinal Chemistry by Sriram, and Yogeeswari
5. Medical Pharmacology, Tripathi
6. Pharmaceutical Chemistry, Chatwal

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- Unit 1 Conductometry- Introduction, Conductivity cell, Conductometric titrations, applications.
 Potentiometry-Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications.
 Polarography - Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications
- Unit 2 UV: Principle, instrumentation and application of UV spectroscopy.
 IR: Principle, instrumentation and application of UV spectroscopy.
- Unit 3 NMR: Principle, The spinning nucleus, Magnetic and non magnetic nuclei, rules to find nuclear spin, effect of external magnetic field, precessional motion and frequency, chemical shift: measurement, shielding and deshielding, factors affecting spin-spin coupling, coupling constants, Instrumentation, interpretation of NMR spectra.
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- MASS:-Principle, instrumentation, types of ions and use of mass spectrometry in the determination of molecular weight
- Unit 4 Chromatography : Introduction to chromatography
 Adsorption and partition column chromatography-Methodology, advantages, disadvantages and applications.
 Thin layer chromatography- Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications.
 Paper chromatography-Introduction, methodology, development techniques, advantages, disadvantages and applications
- Unit 5 Gas chromatography-Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications
 High performance liquid chromatography (HPLC)-Introduction, theory, instrumentation, advantages and applications.

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Books Recommended

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Instrumental Methods of Chemical Analysis by Chatwal.
3. Pharmaceutical Analysis by Kar.
4. Beckett and Stenlake's, Practical Pharmaceutical Chemistry Vol. I and II.

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B.Sc. (Pharmaceutical Chemistry) Third^o Practicals

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Max. Marks : 50

1. Preparation of N-phenyl azo β -naphthol and diphenyl thiourea.
2. Preparation of methyl orange and phenolphthalein.
3. Interpretation of given UV spectrum.
4. Interpretation of given IR spectrum.
5. Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds
6. Assay of paracetamol by UV-Spectroscopy
7. Estimation of dextrose by colorimetry
8. Weight variation, hardness, friability, and disintegration test of tablets.
9. Systematic separation and identification of organic binary mixture.
10. Separation of mixture of amino acid and determination of Rf value by thin layer chromatography.
11. Demonstration experiment on HPLC.
12. Demonstration experiment on Gas Chromatography.
13. Viva-voce
14. Practical record

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