Estd. 1962
"A++" Accredited by
NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004,
MAHARASHTRA
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शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

Ref.No.SU/BOS/Science/438 **Date: 17/07/2025**

To,

The Principal,
All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur.

Subject: Regarding syllabi of B.Sc. Part-I (Sem.I & II) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi, nature of question paper of B.Sc. Part-I (Sem.I & II) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

B.Sc. Part-I (Sem. I & II) as per NEP-2020 (2.0)			
1.	Pharmacology (Entire)	2.	Medicinal Chemistry (Entire)

This syllabus, nature of question and shall be implemented from the academic year 2025-2026 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk(Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2025 & March/April 2026. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar
Dr. S. M. Kubal

Encl: As above

for Information and necessary action

Copy to:

1	Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	Director, Board of Examinations and Evaluation	7	I.T.Cell /Computer Centre
3	Chairman, Respective Board of Studies	8	Eligibility Section
4	B.Sc.-M.Sc. Exam Section	9	Affiliation Section (T.1) (T.2)
5	Internal Quality Assurance Cell (IQAC Cell)	10	P.G. Seminar Section

SHIVAJI UNIVERSITY, KOLHAPUR

Estd. in 1962
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CHOICE BASED CREDIT SYSTEM WITH MULTIPLE ENTRY AND MULTIPLE EXIT OPTIONS

Syllabus

for

B.Sc. Part-I

Medicinal Chemistry (Entire)

SEMESTER I AND II

(Syllabus to be implemented from June 2025)

SHIVAJI UNIVERSITY, KOLHAPUR

NEP-2020 (2.0): Credit Framework for UG (B.Sc.) Programme under Faculty of Science and Technology

SEM (Level)	COURSES			OE	VSC/SEC	AEC/VEC/IKS	OJT/FP/CEP /CC/RP	Total Credits	Degree/Comic. MEME
	Course-1	**Course-2**	**Course-3**						
SEM I (4.5)	DSCI-Introduction to Medicinal Chemistry (2) DSC-II Introduction to Drug Chemistry(2) DSCP-I Lab Course I (Based on DSC I & II) (2)	DSC-I Medicinal Botany (2) DSC-II Advanced studies in animal biology (2) DSCP-I Lab Course II(Based on DSCI & II) (2)	DSC-I Fundamentals of organic chemistry (2) DSC-II Fundamentals of inorganic chemistry(2) DSCP-I Lab Course III (Based on DSC I & II) (2)	Will be selected from SUK basket		IKS-I Introduction to IKS (2)		**22**	**UG Certificate 44**
SEM II (4.5)	DSC-III Drug Chemistry (2) DSC-IV Toxicology Paper(2) DSCP-II Lab Course IV (Based on DSC III & IV) (2)	DSC-III Fundamentals of Biochemistry (2) DSC-IV Fundamentals of microbiology (2) DSCP-II Lab Course V (Based on DSC III & IV) (2)	DSC-III Fundamentals of Physical Chemistry (2) DSC-IV Fundamentals of Analytical Chemistry (2) DSCP-II Lab Course VI (Based on DSCIII & IV) (2)	Will be selected from SUK basket		VEC-I (2) (Democracy, Election and Constitution)		**22**	
Credits	**8(T)+4(P)=12**	**8(T)+4(P)=12**	**8(T)+4(P)=12**	**2+2=4(T)**	**--**	**2+2=4**	**--**	**44**	**Exit Option:4 credits NSQF/ Internship/ Skill courses**

Syllabus for Bachelor of Science Part–I
(B.Sc.-I–Medicinal Chemistry Entire)

1. **Title of the course: B.Sc. Part–I (Medicinal Chemistry)**
2. **Year of Implementation:2025-26**
3. **Introduction:**

Medicinal Chemistry is the integrated field that combines basics of Chemistry, biochemistry, Microbiology and Pharmacy. The Department of Medicinal Chemistry is part of the highly collaborative, interdisciplinary School of Pharmacy. Medicinal Chemistry is a discipline with a traditional focus on organic synthetic chemistry with the broad goals of drug discovery and optimization. The Department of Medicinal Chemistry has always departed somewhat from this tradition given the focus of many of its faculty on the research areas of mechanistic drug metabolism, toxicology, and bioanalytical chemistry. Research in medicinal chemistry encompasses a broad spectrum of activities including studies pursuant to investigationsoftheinteractionofbothdrugsandtoxicsubstanceswithbiologicalsystems, and the relationship of chemical structure and dynamics to biological effect and function. In recent years research activities in the Department have been broadened further by the addition of several faculty members with expertise in the areas of biological mass spectrometry and biophysical virology. Build a strong background in traditional chemistry as well as a fundamental understanding of the chemical, biological and pharmacological actions of pharmaceuticals and biomedical products. Study the application of biological, chemical, and data science to computer-aided design, synthesis, evaluation, and analysis of structurally diverse drugs for the detection, treatment, and cure of human diseases in the only program of its kind in Illinois, and one of just a handful in the country. Practice hands-on techniques by taking lab courses customized for industrial needs in addition to standard lecture-based courses Conduct cutting-edge research under the direction of chemistry faculty working on medicinal and pharmaceutical chemistry, including drug discovery, computational drug design and modeling, and microscopic characterization of biomaterials for regenerative medicine.

Career Opportunities

Through chemical and instrumental analysis, drug design and synthesis, separation and purification of small molecules and biomolecules, pharmaceutical quality control and Assurance, and understanding drug action and safety, you will assemble the skills to develop a career in biomedical science, bio analytical science, biotechnology, medicine, or pharmaceutical science. Analytical chemist, Biotechnologist, Chemical engineer, Health care

scientist, Pharmacologist, Research scientist etc.

4. Programme Outcomes:

After studying the course, the student will be able to…..

- ✓ Understand basis of theoretical as well as practical knowledge of all core and allied subjects of Medicinal Chemistry includes chemical sciences, life sciences, pharmaceutical sciences, mathematical sciences, and computer sciences.
- ✓ Learn the drug design, drug delivery, mechanism of action, chemical moiety involved in the dug, drug manufacturing, QA/QC and regulation etc.
- ✓ Understand and apply operative components of Medicinal Chemistry in pharmaceutical, clinical pharmacy, hospital pharmacy, community pharmacy, pharmaceutical care, and other related areas for the benefit of the use of medications.
- ✓ Emphasis on drug discovery and design, drug delivery, drug action, drug analysis, cost effectiveness of Medicines (Pharmacoeconomics), drug regulatory affairs etc.
- ✓ Apply for higher studies in the field of Chemistry, Pharmaceutical Chemistry and Medicinal Chemistry.

5. General Objectives of the Course:

- ✓ The content of the syllabus has been framed as per the UGC norms.
- ✓ The students are expected to understand the fundamentals, principles, and concepts as well as recent developments in the subject area.
- ✓ The practical course is in relevance to the theory courses to improve the understanding of the concepts.

6. Eligibility of course:

For admission into bachelor's degree of medicinal chemistry, one should pass higher secondary school certificate examination i.e., H.S.C. science or 12^{th} science or equivalent examination from a recognized board.

7. Duration:

The duration for B.Sc. degree course is of 3years with semester pattern of 6 semesters.

• B.Sc.-Part-I: Semester I&II

8. Medium of Instruction: English

9. Structure of the (B.Sc. I) course:

Duration–One year

B.Sc.-I comprises of total two semesters. In each semester there will be nine theory papers and Practical examination will be conducted annually

10. Nature of Question Paper for Semester Pattern

Time: 2 hrs. **Total marks:** 40

Instructions:

1. All questions are compulsory.
2. Numbers in right indicate full marks.
3. Use of scientific calculator is allowed.

Q.No.1) Multiple choice questions (1 × 08) .....(08)

Q.No.2) Attempt any two out of three (2 × 08) .....(16)

Q.No.3) Attempt any four out of six (4 × 04).....(16)

Internal Examination

CCE-I: Marks =10

CCE-II: Marks=10

11. Nature of Question Paper for Practical Examination

Time: 6 hrs. **Total Marks:** 50

Perform two experiments.

Ques.1) Experiment 1 ..... 20 marks

Ques.2) Experiment 2 ..... 20 marks

Ques.3) Journal ..... 05 marks

Ques.4) Oral…..... 05 marks

Total= 50 marks

Semester-I

Course-I DSC-I

Introduction to Medicinal Chemistry (Paper-I)

Theory: 30 Hours (2 Credits)

Course Outcomes:

1. To understand the basic principles of medicinal chemistry & explain the role of medicinal chemistry in drug discovery and development. Define key terms such as pharmacodynamics, pharmacokinetics, and drug metabolism.
2. To describe drug-receptor interactions & understand the molecular basis of drug action and the importance of target interactions.
3. To analyze the structure-activity relationship (SAR) & identify how structural modifications affect biological activity and drug efficacy.
4. To explain drug metabolism and pharmacokinetics. Understand the ADME (Absorption, Distribution, Metabolism, and Excretion) processes. Evaluate the impact of metabolism on drug activity and toxicity.
5. To explore synthetic strategies in drug design. Apply knowledge of organic chemistry to design or modify therapeutic agents.

Unit-I Introduction to medicinal chemistry **06L**

- Introduction, Definition and Scope of Medicinal Chemistry
- History of Medicinal Chemistry
- Basic Concepts in Medicinal Chemistry
- Structure-Activity Relationship (SAR)
- Drug design and development
- Target identification and validation

Unit-II Biotechnology and Biopharmaceuticals: **06L**

- Monoclonal Antibodies
- Biologics and Biosimilars
- RNA-based Therapeutics (e.g., mRNA vaccines)

Unit-III Pharmacogenomics and Personalized Medicine **10L**

- Genetic Variability in Drug Response
- Drug-Drug Interactions
- Tailoring Drug Therapy to Individual Genetic Profiles

- Vaccines and Immune System Modulation:
- Vaccine Development
- Immune Modulators (e.g., cytokines, immune check point inhibitors)

Unit-IV Analytical Chemistry **08L**

- In pharmaceutical chemistry, techniques such as chromatography, spectroscopy, and mass spectrometry are used to analyze drug purity, stability, and potency,
- Ensuring quality control throughout the drug development process.

Reference Book:

1. Foye's Principles of Medicinal Chemistry by Thomas L. Lemke, David A. Williams, and Victoria F. Roche
2. Principles of Medicinal Chemistry by William Foye, Thomas L. Lemke, and David A. Williams
3. "Drug Design: Principles and Applications" by Kenneth M. Merz, Dagmar Ringe, and James T. P. Yates
4. Medicinial Chemistry: Principles and Practice" by William
5. "Wilson and Griswold's Textbook of Organic Medicinal and Pharmaceutical Chemistry" by John M. Beale Jr. and others
6. "Medicinal Chemistry: Principles and Practice" by John M. Beale Jr.
7. "Introduction to Medicinal Chemistry " by Graham L. Patrick

Semester-I

Course-I DSC-II

Introduction to Drug Chemistry (Paper-II)

Theory:30Hours (2 Credits)

Course Outcomes:

1. To understand the basic concepts of drug discovery and development, including lead identification, optimization, and structure-activity relationships (SAR).
2. To explain the chemical principles involved in drug design, including physicochemical properties, bioisosterism, and pharmacophores.
3. To analyze the mechanisms of action of various classes of therapeutic agents and correlatetheir structures with pharmacological activity.
4. To describe the metabolic pathways of drugs in the human body and predict the impact of metabolism on drug activity and toxicity.
5. To evaluate the synthetic pathways of important drug molecules and their intermediates.
6. Toapplyconceptsofmedicinalchemistrytotherationaldesignofnewdrugmolecules targeting specific diseases or receptors.

Unit-I Drug Classification and Nomenclature 07L

- Drug Classes: Study of various drug categories such as antibiotics, analgesics, antipyretics, and antihypertensive.
- Nomenclature Systems: Learning the systematic naming conventions for organic compounds, including polycyclic and heterocyclic structures

Unit-II Physicochemical Properties of Drugs 07L

- Solubility and its Effect on Drug Absorption
- Partition Coefficient and Lipophilicity
- Ionization and its Impact on Drug Activity
- pKa and its Role in Medicinal Chemistry
- Drug Stability (Chemical, Physical, and Microbiological)

Unit-III Drug Absorption, Distribution, Metabolism, and Excretion (ADME) 07L

- Pharmacokinetics Overview
- Bioavailability and Bioequivalence
- Blood-Brain Barrier and Drug Penetration

- Metabolism and Enzymatic Processes
- Excretion Mechanisms: Renal and Biliary Excretion

Unit-IV Drug Targets **09L**

- Receptors (e.g., G-protein-coupled receptors, Ion Channels, Enzyme Receptors)
- Enzymes as Drug Targets
- Enzyme inhibition and activation
- Inhibitors (e.g., ACE inhibitors, Protease inhibitors)
- Nucleic acids as Drug Targets (Anticancer agents, Antiviraldrugs)

Reference Book:

1. The Organic Chemistry of Drug Design and Drug Action" by Richard B. Silverman and Mark W. Holladay
2. "Textbook of Drug Design and Development" by Ray T. Falcon
3. "Pharmacology: Drug Actions and Reactions" by R. R. N. Yadav and G. P. Deodhar

Lab course

Practical: 60 Hours (2Credits)

1. Isolation and purification of medium compounds (e.g., caffeine, Aspirin.)
2. Estimation of Aspirin from pharmaceutical tablet
3. Physical and chemical characterization of medicinal compounds (M.P./B.P, Solubility)
4. TLC technique for separation and analysis of medicinal compounds.
5. Preparation of Paracetamol.
6. Colorimetric estimation of iron from drug sample.
7. |Estimation of vitamin-C from drug/fruit sample.
8. Detection of elements and functional group present in drug sample.
9. Preparation of antacid using ingredients like $CaCO_3$, Mg(OH)and other excipients.

Semester-I
Course-II DSC-I
Medicinal Botany (Paper-I)
Theory: 30 Hours (2Credits)

Course Outcomes:

1. To understand the importance of herbs and herbal drugs.
2. Know about the traditional systems of medicine
3. Recognize the basic medicinal plants
4. Understand the chemical constituents of the medicinal plants
5. Get an idea about processing of medicinal plants
6. Understand the conservation strategies of medicinal plant.
7. Realizes primary and secondary metabolites and their differences, major types-terpenes, phenolics, alkaloids, terpenoids, steroids.

Unit– I Plant Histology 08L

Introduction, History, TSM, concept and Principles of Ayurveda, Siddha, Unani and, Homeopathy; Importance of TSM; Concept and Principles of Naturopathy and Tibetan Medicine; Concept of herbalism and its significance. Introduction to Phyto-medicines and herbal raw materials.

Unit II Concepts in Medicinal and Aromatic Plants 07L

Important aromatic plants of India with their systematics, geographical distribution and uses. Introduction and historical background of aromatic plants. Aromatic and cosmetic products. Raw material for perfumes etc. Cosmetic Industries.

Taxonomic descriptions and uses of

- Important aromatic plants–citronella, geranium, lavender, lemongrass
- Aromatic spices-clove, cinnamon, nutmeg
- Plant drugs from Grandmas Pouch (Aloe, Haldi, Tulsi, Sandalwood, Adulsa, Dried Ginger)

Unit III Ethnobotany and Folkmedicines 08L

- Ethnobotany and Folk medicines: Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany.
- Folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac,

diabetics, Blood pressure and skin diseases.

Unit IV: Metabolites **07L**

Metabolite's General introduction, Primary metabolites outline, detailed study with respect to chemistry, evaluation, preservation, storage, therapeutic uses and commercial utility as Pharmaceutical Aids and/or Medicines for the following

Primary metabolites:

a) **Carbohydrates**: Agar, Honey

b) **Lipids** (Waxes, fats, fixedoils): Chaulmoogra oil, Wool Fat

Secondary metabolites

Introduction to secondary metabolites, biosources, therapeuticuses and of following secondary metabolites:

a) **Alkaloids:** Vinca,Rauwolfia

b) **Phenylpropanoids and Flavonoids:**Lignans,Tea

c) **Volatileoils:** Clove, Cinnamon

References:

1. Pharmacognosy Trease and Evans. 16th Edition, 2009, Published by ELBS, London ISBN978-0702029332
2. Drugs of Natural Origin, 7th edition 2015 Gunnar Samuelsson Swedish Pharmaceutical Press, ISBN978-91-980942-5-1.

Reference books:

1. Medicinal natural products, a biosynthetic approach, 3rd edition, 2009 Paul Dewick, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom, ISBN0 471 49640
2. Pharmacognosy, phytochemistry, Medicinal Plants. 2nd edition Jean Bruneton: Springer Verlag, 2008, ISBN:1898298130, 2743000287

Semester-I

Course-IIDSC-II

Advanced Studies in Animal Biology (Paper-II)

Theory: 30 Hours (2 Credits)

Course Outcomes:

1. To enable the students to learn the basics of Animal Sciences.
2. To enable the students to get knowledge of various Human organs and their functions
3. To enhance the knowledge and curiosity among the students for Animal science.
4. To prepare students for further studies, helping in their bright career in the subject.
5. To expose the students to different processes used in industries and in research field

Unit I-Animal Physiology: 09L

Digestive System – Structure and Functions of Digestive System

Respiratory System-Structure and Functions of Respiratory System

Circulatory System - Structure and Functions of Circulatory System

Excretory System - Structure and Functions of Excretory System

Nervous System - Structure and Functions of Nervous System

Unit–II Histology of Mammalian Organs: 09L

i. T.S. of Skin

ii. T.S. of Stomach

iii. T.S. of Intestine

iv. S. of Kidney

v. T.S. of Testes

vi. T.S. of Ovary

vii. T.S. of Uterus

viii. T.S. of Liver

ix. Fluid Connective Tissue–Blood

Unit–III Immunology: 06L

- Introduction to basic concepts in Immunology, Pathogens, Innate Immunity and Adaptive Immunity
- Hybridoma Technology: Monoclonal antibodies in diagnosi therapeutics.

Unit–IV Concept and Scope of Toxicology: 06L

- Definition, History, Recent development, Disciplines of toxicology. Classification of toxicants, toxic effects, principal aspects and importance of toxicology.

References:-

1. Clark W. R. Experimental functions of Modern Immunology. Immunobiology-Charles A. Janewayandoy hers– 2001.(Unit III & IV)
2. Kotapal P. K. A textbook of vertebrates
3. Pandey Kamleshwar. Shukla J. P. and Trivedi S. P. (2005): Fundamental of Toxicology. New Central book agency PVT. LTD. Kolkata. (Unit I&II) Human Physiology–by A. C. Guyton. Saunders Company Londan, Toronto

Lab course

Practical: 60 Hours (2 Credits)

1. Identification of plant or plant parts from grandma' spouch Tulsi, Adulsa, Dried Zinger, Haldi, Sandle, Aloe
2. Qualitative tests for Carbohydrates (Molisch's Test, Fehling's Test, Benedict's Test)
3. Separation of Volatile oils by paper chromatography
4. Cultivation practices of aromatic plants & Spices
5. Qualitative analysis of Polyphenols, Tannins, Alkaloids
6. Blood group detection.
7. R.B.C. Count
8. W.B.C. Count
9. Bleeding and Clotting Time
10. Preparations of hemin and Haemochromogen crystals.
11. Determination of Grip Strength.
12. Measurement of Blood Pressure by Sphygmomanometer.
13. Study of Human histological slides.

i. T.S. of Skin ii. T.S. of Stomach

iii. T.S. of Intestine iv. V.S. of Kidney

v. T.S. of Testes vi. T.S. of Ovary

vii T.S. of Uterus viii. T.S. of Liver

Semester I

Course-III DSC-I

Fundamentals of Organic Chemistry (Paper-I)

Theory: 30 Hours (2 Credits)

Course Outcomes:

1. To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications
2. To study various spheres of chemicals sciences.
3. To enhance student sense of enthusiasm for chemistry.
4. To involve the mina intellectually stimulating experience of learning in a supportive environment.

Unit I: Fundamentals of Reaction 08 L

Introduction, Curved arrow notations, Cleavage of Bonds: Homolysis and Heterolysis. Organic molecular species: Nucleophiles and electrophiles. Types of reagents and organic reactions. Electronic Displacements: Inductive Effect, Electrometric Effect, Resonance and Hyperconjugation effect, Reactive Intermediates: Generation, Structure, Stability and Reactions of Carbocations, Carbanions and carbon free radicals.

Unit II: Stereochemistry 07L

Introduction, Types of Stereoisomerism, Optical Isomerism: Concept of Chirality ,Elements of Symmetry, Optical Isomerism in tartaric acid, 2,3-Dihydroxybutanoic acid, Enantiomers, Diastereomerism and Meso compounds, Geometrical isomerism in maleic acid and fumaric acid, aldoximes and ketoximes and alicyclic compounds. Nomenclature of stereoisomers: Erythro and threo, R and S, E and Z.

Unit III: Chemistry of Aliphatic Hydrocarbons 09 L

A) Introduction: Alkanes: preparation, catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis from Grignard reagent. Alkenes: addition reaction, Saytzeff's rule. Dienes and types of dienes. Alkynes: preparation of acetylene form calcium carbide, preparation of higher alkynes by dehalogenation of tetra halides, Addition reaction.

B) Aromatic Hydrocarbons:

Concept of Aromaticity, Huckel'srule, Molecula rorbital theory of benzene and naphthalene

Unit IV: Heterocyclic compounds 06 L

Introduction, Classification, Nomenclature of heterocyclic compounds. Structure and aromaticity of pyrrole, furan, thiophene and pyridine. Methods of synthesis, properties and chemical reactions of Pyrrole

References:

i. Graham Solomon, T. W., Fryhle, C. B. & Dnyder, S. A. Organic Chemistry, John Wiley & Sons (2014).

ii. McMurry, J. E. Fundaentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013 m.

iii. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).

iv. Eliel, E. L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.

v. Finar, I. L. Organic Chemistry (Vol. I & II), E. L. B. S.

vi. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Pearson, 2010.

vii. Bahl, A. & Bahl, B. S. Advanced Organic Chemistry, S. Chand, 2010.

viii. D. Nasipuri: Stereochemistry of Organic compounds

ix. R. L. Madan, Chemistry for Degree Students (B.Sc. First Year), S. Chand Publication

Semester I
Course-III DSC-II
Fundamentals of Inorganic Chemistry (Paper-II)
Theory: 30 Hours (2 Credits)

Course Outcomes:

1. To develop interdisciplinary approach of the subjects for students opting for specialization in other subjects at latter stages of graduation.
2. To expose the students to various emerging new areas of Chemistry and their applications in various spheres of chemical sciences.
3. To prepare students for further studies, helping in their bright career in the subject.
4. To expose the students to different processes used in industries and in research field

Unit I: Structure and Bonding: Ionic Bond 06L

Introduction, Types of bonds. Ionic bond, Covalent bond, Co-ordinate bond, Metallic bond, Hydrogen bond, Ionic Bond: General Characteristics of ionic bonding, Formation of ionic bond, Energetics of ionic bond formation, Born-Haber cycle and its applications, Fajan's rules, Radius ratio, Radius ratio effects and calculation of radius ratio for octahedral geometry, Structure of NaCl, Zinc Blende (ZnS), Rutile (TiO_2).

Unit II: Structure and Bonding: Covalent Bond 06L

VBT approach, Concept of hybridization and different types of hybridizations (sp, sp^2, sp^3, sp^3d, sp^3d^2 and sp^3d^3) with examples, Valence shell electron pair repulsion theory (VSEPR), VSEPR approach, assumptions, limitations, VSEPR theory and shape of molecule.

Unit III: Coordination Complexes 09L

Introduction, Definition and formation of co-ordinate covalent bond in BF_3-NH_3, $[NH_4]^+$, Description of the terms: ligand, co-ordination number, co-ordination sphere, Effective atomic number, IUPAC nomenclature of coordination compounds. Essential and trace elements in biological process, Metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Na^+ and K^+

Unit IV: Molecular Orbital Theory (MOT) 09L

Introduction to LCAO method, Formation of bonding, anti-bonding and non-bonding molecular

orbitals, Conditions for successful overlaps, Types of overlaps, Energy level sequence for molecular orbitals when n = 1 and n = 2, Bond order and it's significance, Molecular orbital diagrams for

a. Homonuclear diatomic molecules: N^{2+}, N^{2}, N^{2-}, O^{2}, O^{2+}, O^{2-}

b. Heteronuclear diatomic molecules: CO, NO

References

1. Principles of Inorganic Chemistry: Puri, Sharma and Kalia
2. Inorganic Chemistry: Gary L. Miessler and Donald A. Tarr
3. Atomic structure and chemical bonding: Manas Chanda
4. Quantum Chemistry: R. K. Prasad
5. Inorganic Chemistry: Principles of Structure and Reactivity: James H. Huheey, Keiter, Medhi
6. Modern Inorganic Chemistry: R. D. Madan
7. Concise Inorganic Chemistry: J. D. Lee

Lab course

Practical: 60 Hours (2 Credits)

1. Estimation s(any two):
    1. Estimation of Vitamin C
    2. Estimation of Aspirin.
2. Organic Qualitative Analysis:

Detection of physical constant, type, functional group, elements, and Confirmatory test. Identification of Organic Compounds (four containing at least one extra element-N, S, Cl. Br, I)

a) Acids: Oxalic acid, Benzoic acid, cinnamic acid

b) Phenols: Beta-Naphthol, Resorcinol

c) Base: Aniline, p-Nitroaniline

d) Neutral: Acetone, Acetanilide, Chloroform, m-dinitrobenzene, Thiourea, Bromobenzene

3. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
4. Preparations of derivatives of organic compounds
    a) Nitration of nitrobenzene
    b) Oximes of aldehydes & ketones
    c) 2,4dinitrophenylhydrazone of aldehydes & ketones
5. To prepare standard 0.1 N oxalic acid solution and to determine the strength of given potassium permanganate solution.
6. To determine quantity of Fe(II) ions from the given solutions by titrating it with 0.1 N $K_2Cr_2O_7$ solution by using internal indicator
7. To estimate amount of Cu(II)ions by iodometric titration by using $Na_2S_2O_3$ solution
8. Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method
9. Chromatography: Separation and identification of cations by Paper chromatographic technique from the following mixtures:

a) Ni^{2+}, Cu^{2+} b) Ni^{2+}, Co^{2+}

References:

1. Vogel's textbook of Quantitative Chemical Analysis (Longman ELBS edition)
2. A TextBook of Quantitative Inorganic Analysis: A. I. Vogel (Third Ed.)
3. Mikes O. Laboratory Hand book of Chromatographic and Allied Methods Elles, Harwoods series on analytical chemistry John Wiley and Sons 1979.
4. Chromatography:H. Kaur
5. Chemistry for Degree students (B.Sc. First Year): R. L. Madan (S. Chand and Company)

Semester–II
Course- I DSC-II
Drug Chemistry Paper–I
Theory: 30 Hours (2 Credits)

Course Outcomes:

1. To understand the basic concepts of drug discovery and development, including lead identification, optimization, and structure-activity relationships (SAR).
2. To explain the chemical principles involved in drug design, including physicochemical properties, bioisosterism, and pharmacophores.
3. To analyze the mechanisms of action of various classes of therapeutic agents and correlate their structures with pharmacological activity.
4. To describe the metabolic pathways of drugs in the human body and predict the impact of metabolism on drug activity and toxicity.
5. To evaluate the synthetic pathways of important drug molecules and their intermediates.

Unit-I Classification of Drugs and their Mechanisms of Action (07)

- **Antibiotics and Antimicrobials**
  - Mechanism of Action, Spectrum of Activity
  - Examples: Penicillins, Cephalosporins, Tetracyclines
- **Analgesics and Anti-inflammatory Drugs**
  Mechanism of Action (NSAIDs, Opioids, Corticosteroids)

Unit-II Anticancer Drugs (06)

- Mechanisms, Drug Classes (Alkylatingagents, Antimetabolites, Naturalproducts)
- **Antihypertensive Drugs**
- Diuretics, Beta-blockers ,ACE inhibitors

Unit-III Drug Design and Development (08)

- Rational Drug Design
- Structure-based Drug Design
- Ligand-based Drug Design
- High Throughput Screening and Drug Discovery
- Clinical Trials (Phase I-IV)

Unit-IV Pharmaceutical Dosage Forms and Drug Delivery (09)

- Types of Dosage Forms: Tablets, Capsules, Injections, etc.
- Routes of Drug Administration
- Oral, Parenteral, Topical, Inhalational Controlled Release Drug Delivery Systems

Reference Book:

1. The Organic Chemistry of Drug Design and Drug Action "by Richard B. Silverman and Mark W. Holladay
2. "Textbook of Drug Design and Development" by Ray T. Falcone
3. "Pharmacology: Drug Actions and Reactions" by R. R. N. Yadav and G. P. Deodhar

Semester-II
Course-1 DSC-II

Toxicology Paper-II

Theory: 30 Hours (2 Credits)

Course Outcomes:

1. To understand toxicological principals.
2. To understand the role of medicinal chemistry in drug safety
3. To understand risk assessment and drug development.
4. To study strategies for mitigating toxicity and ethical considerations and drug safety.

Unit-I Introduction to Medicinal Chemistry and Toxicology (10)

Definition, scope, drug discovery, and development

Introduction to Toxicology: Basic principles of toxicology, types (clinical, forensic, environmental).

Toxicology in Medicinal Chemistry: The importance of understanding toxicological principles in drug design and development.

Principles of Toxicology

Toxicokinetics vs. Toxicodynamics: ADME (Absorption, Distribution, Metabolism, Excretion) and how these factors influence toxicity.

Dose-Response Relationship: Threshold doses, no-observed-adverse-effect levels (NOAEL), maximum tolerated dose (MTD)

Unit-II Toxicology and Side Effects (06)

- Toxicity Mechanisms
- Adverse Drug Reactions (ADRs)
- Therapeutic Index and its Importance in Drug Safety

Unit- III Drug-Induced (06)

Acutevs. Chronic Toxicity: Short-term versus long-term effects of drugs.

Drug-Drug Interactions and Toxicity: How certain drugs may enhance or inhibit toxicity when used together.

Adverse Drug Reactions (ADRs): Classification, types (Type A: predictable, Type B: unpredictable), and management.

Unit-IV Nanotoxicology (08)

Toxicology of Nanomaterials: Unique properties of nanomaterials (e.g., size, surface area) that impact toxicity.

Mechanisms of Nanotoxicity: Cellularuptake, oxidativestress, and inflammation.

Safety Concerns in Nanomedicine: Risk assessment and regulatory challenges for nano pharmaceuticals.

Reference book-

1. Toxicology:The Basic Science of Poisons by Louis J. Casarett and John Doull
2. Toxicological Chemistry and Biochemistry by Stanley E. Manahan
3. Environmental Toxicology and Risk Assessment: A Practical Approach (edited by Thomas G. Bolger)
4. A Textbook of Modern Toxicology (by Ernest Hodgson)

Lab course

Practical: 60 Hours (2 Credits)

1-Detection of heavy metals using spot test. (lead/As)

2-Analysis of pesticides in vegetables

3-Prepartion of standard solution of toxic substances (lead, Hg, As)

4 -Effect of pH on Drug solubility.

5-Detection of Paracetamol tablets.

6- Detection of Ranitidine in tablets.

7-Solubility study of common drugs.

8-Analysis of drug contamination using paper chromatography.

9-Prepartion of Benzocaine (local anesthetic)

10-Identification of Adulteration in painkiller.

(Chalk power, starch, dyes)

SEMESTER_II
Course-II DSC-II
Fundamentals of Biochemistry (Paper-I)
Theory: 30 Hours (2 Credits)

Course Outcomes:

1. Students will make knowledgeable with respect to the subject and its practical applicability
2. To promote understanding of basic and advanced concepts in biochemistry.
3. To expose the students to various emerging areas of biochemistry.
4. To expose the students to different processes used in industries and in research field.
5. To develop their ability to apply the knowledge of biochemistry in day-to-day life.
6. To prepare the students to accept the challenges in life sciences.
7. To develop skills required in various industries, research labs and in the field of human health.

Unit I-Solution and Colligative Properties 09L

Concentration units- molarity, molality, normality and mole fraction. Types of solutions – homogenous and heterogeneous. Factors affecting solubility, solubility curves. Henry Lawand its applications. Osmotic pressure- laws of osmotic pressure, Hypo, hyper and isotonic solutions. Measurement of osmotic pressure, Effect of osmotic pressure on living cells- hemolysis, plasmolysis etc. Rault's law, elevation in boiling point, depression in melting point and their applications in determination of molecular weight

Unit II-Acids, Bases and Buffer 09L

Modern concepts of acids and bases. Ionization of acids, Dissociation of water, Ionic product of water, pH, Determination of pH. Dissociation of weak acids. Effect of salt on dissociation of acids. Dipolar ions and isoelectric pH of amino acids and proteins. Buffer equation, buffer capacity. problems based on buffer solutions. Buffers of blood plasma, red blood cells and tissue fluids. Use of buffer solutions and indicators.

Unit III –Phytochemicals and Healtheffects 06L

Introduction, Different types of phytochemicals, Structure, sources, properties, classification and importance of carotenoids and Flavonoids. Health effect and benefits of carotenoids and Flavonoids

Unit IV-Biochemical and Environmental Toxicology 06L

Introduction, toxicants, chemical nature of toxicants, pathways of toxicants into ecosystem, effects of toxicants on ecosystem, biochemical aspects of biodegradation, general factors of biodegradation and biomarkers.

Reference book

1. Physical chemistry by Peter Atkins and juliodepaula
2. Principles of modern chemistry by Davidw. Oxto by, H. P. Gillis, Alancampion
3. Environmental Toxicology: Biological and health effects of pollutants by B. D. Goldstein
4. Principles of Biochemical toxicology by john A timbrell.

Semester –II
Course-IIDSC-I
Fundamentals of Microbiology (Paper-II)
Theory: 30 Hours (2 Credits)

Course Outcomes:

1. To make the students' knowledgeable with respect to the subject and its practicable applicability.
2. To promote understanding of basic and advanced concepts in Microbiology.
3. To expose the students to various emerging areas of Microbiology.
4. To prepare students for further studies, helping in their bright career in the subject.
5. To expose the students to different processes used in industries and in research field.
6. To develop their ability to apply the knowledge of Microbiology in day-to-day life.
7. To prepare the students to accept the challenges in life sciences.
8. To develop skills required in various industries, research labs and in the field of human health

UNIT I: Introduction of Microbiology 07L

The place of microorganisms in living world -Prokaryotic and eukaryotic protists, Whittaker's five kingdom concept

Definition, Introduction to types of Microorganisms–Bacteria, Algae, Fungi, Protozoa and virus Morphology and Cytology of Bacteria–

i) Morphology of Bacteria-Size, Shape, Arrangements

ii) Structure and functions of - Cell wall, Cell membrane, capsule and slime layer, Flagella, Pilli, Nuclear material, Mesosome, Ribosome Beneficial and Harmful activity of Microorganisms Applied Branches of Microbiology.

Unit II-Microbial nutrition and Culture Media 07L

- Nutritional requirements of microorganisms: Water, Micronutrients, Macronutrients, Carbon, Energy source, Oxygen and Hydrogen, Nitrogen, Sulphur and Phosphorous and growth factors auxotroph, prototroph and fastidious organisms
- Nutritional types of microorganism based on carbon and energy sources- autotrophs, heterotrophs, phototrophs, chemotrophs, photoautotrophs, chemoautotrophs, photoheterotroph, chemoheterotrophs.
- Common components of culture media and their functions.
- Types of culture media – Natural and Synthetic, semi synthetic, Differential, Enriched, Enrichment, Selective, Transport, Indicator media.

Unit III: Microscopy and Staining 08L

- Types of Microscopes–Light (phase contrast, darkfield, interference, fluorescent microscope), Electron Microscope
- Definitions of dye and stain
- Classification of stains–Acidic, Basic and Neutral
- Principles, Procedure, Mechanism and application of staining procedures- Monochrome staining, Negative staining, Differential staining

Unit IV: Control of Microorganisms 08L

- Definitions of sterilization, disinfection & sanitization.
- Physical agents of control of microorganisms- temperature (dry heat and moist heat). Filtration(asbestos and membrane filter)
- Chemical agents for control of microorganisms- mode of action, applications and advantages of – Phenolic and phenolic compound, Alcohol (Ethyl alcohol), Halogen compounds (Chlorine and Iodine), Heavy metal (Cu and Hg)

References:

1. General Microbiology by R. Y. Stanier 5th edtion, McMilan, London
2. Fundamental Principles of Bacteriology by A. J. Salle, Tata McGrawHill.
3. Brock's Biology of Microorganisms M. T. Madigan 12th edition
4. Fundamentals of Microbiology by Frobisher, Hindsdill, Crabtree, Good Heart, W.B. Saunders Company, 7th edition
5. Microbiology by Pelczar, M. J. Jr, Chan E. C. S., Krieq, N. R.5th edition, McGraw Hills Publication.
6. Microbiology by Prescott, Herleyand Klein, IInd edition
7. A textbook of Microbiology by Anantnarayan-Orient Logman, Bombay
8. Experimental Microbiology by Rakesh Patel Vol. I and Vol. II

Lab course

Practical: 60 Hours (2 Credits)

1. Preparation of cotton plugs for test tubes and flasks.
2. Wrapping of plates and pipettes.
3. Use, care and study of compound microscope.
4. Demonstration of laboratory equipment's-Incubator, Autoclave, Hot air oven, Seitzfilter, Laminar air flow, Distilled water plant, anaerobic jar.
5. Microscopic examination of bacteria by monochrome staining method and Gram staining
6. Microscopic examination of bacteria by Negative staining method
7. Effect of copper metal on bacteria.
8. To study efficacy of alcohol.
9. Preparation and sterilization of nutrients broth, nutrient sagar, MacConkey's agar, Seaboard's agar.
10. Isolation of bacteria by streak plate technique, pour plate technique, Spread platetechnique.
11. Preparation of standard solutions (%, Molar, Molal and Normal) of acids and alkali, stock and working solutions.
12. Preparations of buffer solutions of known pH and molarity using pH meter ((Bicarbonate/phosphate/acetate).)

SEMESTER_II
Course-III DSC-I
Fundamentals of Physical Chemistry (Paper-I)
Theory: 30 Hours (2 Credits)

Course Outcomes:

1. To enable the students to learn the concept of energy.
2. To make student familiar about chemical processes, reactions, energy changes during the reaction
3. To understand thermodynamic and thermochemical concepts and importance of functions of state.
4. To train students to calculate different equilibrium constants.
5. To clear the concept of pH, EMF.

UnitI: Thermodynamics 08L

Introduction, Basic concepts of thermodynamics, First law of thermodynamics, Spontaneous and non-spontaneous process with examples, Statements of second law of thermodynamics, Efficiency of heat engine. Entropy, Physical Significance of entropy, Statement of Third Law of thermodynamics and calculation of absolute entropies of substances. Important principles and definitions of thermochemistry.

Unit II: Chemical Equilibrium 6L

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium, Distinction between ΔG and ΔG^{o}, Le-Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.

Unit III. Electrochemistry 08L

Introduction, Basic terms involved in electrochemistry, Concept of EMF of a cell, Standard electrode potential, Nernst equation, Types of electrodes: Metal-metal ion electrode, Amalgam electrode, Gas electrode, Metal –insoluble salt electrode, Oxidation-reduction electrode, pH determination using hydrogen electrode and quinhydrone electrode

Unit IV. Chemical Kinetics 08L

Introduction, Rate of reaction, Definition and units of rate constant, Factors affecting rate of reaction. (Nature of reactant, Concentration, pressure, temperature and catalyst). Order and Molecularity of reaction, Zero order reaction, first order reaction, Characteristics of first order

reaction, examples, Pseudo-unimolecular reactions, examples. Second order reaction, examples Characteristics of Second order reaction, Concept of energy of activation, Numerical Problems.

References:

1. Undergraduate physical chemistry, UGC curriculum Vol. I-Guria-Gurtu Pragati Prakashan.
2. Principles of Physical Chemistry Puri, Sharma and Pathania, Vishal Publishing house, 44th Edition.
3. Textbook of physical chemistry–P. L. Soni, O. P. Dharmatma, U. N. Dash Sultan Chand and Sons.
4. University general chemistry-An introduction to chemical science-C. N. R. Rao Macmillan.
5. Essentials of physical chemistry–Arun Bahl, B. S. Bahl, G. D. Tuli S. Chand and company Ltd.
6. Chemical kinetics 3rd edition Keith J. Laidler Pearson publication.
7. Atkins P. W., Paula J. De, Atkins Physical Chemistry, Oxford University Press

SEMESTER-II

Course-III DSC-II

Fundamentals of Analytical Chemistry (Paper-II)

Theory: 30 Hours (2 Credits)

Course Outcomes:

1. Students should understand error analysis, types of errors, and deviations.
2. Students should understand separation techniques, like chromatography and electrophoresis.
3. Students should understand electroanalytical techniques like Potentiometry, Conductometry and pH-metry
4. To prepare students for further studies, helping in their bright career in the subject.

UNIT I: Methods of Statistical analysis 08L

- Types of error, personal errors, methodic errors, precession, absolute error, relative error, relative percent error, deviation, standard deviation. Problems based on errors and precision

UNIT II: Separation Techniques 07L

- **Chromatography:** General principles, classification of chromatographic techniques, normal and reverse phase, bonded phase chromatography, stationary phases.
- **Column Chromatography:** Column packing, sample loading, column development, detection
- **Gel electrophoresis:** determines the mass, the charge and the interactions of biological Molecules.

UNIT III: Electroanalytical techniques 08L

- Introduction of electroanalytical techniques,
- **Potentiometry:** Introduction, Principle, working,and applications of Potentiometry.
- **Conductometry:** Introduction, Principle, working, and applications of Conductometry.

- **pH-metry:** Introduction, Principle, working, and applications of pH-metry.

UNIT IV: Spectral analysis techniques 07L

- **Colorimetry and UV-Visible spectroscopy:** Introduction, types of electronic transitions, beer lamberts law and applications of UV-Visible spectroscopy.
- **IR spectroscopy:** Introduction, modes of vibrations, common functional groups and their frequencies, sampling techniques and applications of IR spectroscopy

References:

1. Instrumental methods of Chemical analysis-B. K. Sharma.
2. Instrumental methods of Chemical analysis-H. Kaur.
3. Analytical Chemistry, VIth Ed. Gary D. Christian.
4. Basic Concepts of analytical Chemistry-S. M. Khopkar.
5. Fundamental of analytical Chemistry-Skoog and West.
6. Analytical Chemistry-Alka Gupta (Pragati Prakashan).
7. Instrumentation methods of chemical analysis, Chatwal– Anand, Himalaya publishing House.

Lab course

Practical: 60 Hours (2 Credits)

1. To investigate the reaction between $K_2S_2O_8$ and KI with equal initial concentration of reactants.
2. To investigate the reaction between $K_2S_2O_8$ and KI with unequal initial concentration of reactants.
3. To determine normality of weak acid by titrating it against strong alkali conductometrically.
4. To prepare following buffer solutions and determine their buffer capacity
   I) Sodium Acetate–Acetic Acid
   II) Ammonium chloride–Ammonium hydroxide
5. Determination of Enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
6. Determination of heat of ionization of weak acid by using polythene bottle.
7. Analysis of aspirin by Conductometry
8. Analysis of calcium from calcium tablet by titration with EDTA.
9. Estimation of Alkali content in Antacid tablet using HCl.
10. To verify beer-lamberts law by Colorimetry.
11. Separation of amino acids by paper chromatography
12. Separation of mixture of organic compounds by thin layer chromatography

References:

1. Vogel's textbook of Qualitative Chemical Analysis (Longman ELBS edition)
2. Vogel's textbook of Quantitative Analysis (Longman ELBS edition)
3. Practical Organic Chemistry by A. I. Vogel
4. Comprehensive Practical Organic Chemistry Qualitative Analysis by V. K. Ahluwali.
5. A TextBook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis: A.I. Vogel (Third Ed.).
6. Mikes O. Laboratory Hand book of Chromatographic and Allied Methods Elles, Harwoods series on analytical chemistry John Wiley and sons 1979.
7. Skoog D. A. Holler F. J. and Nieman T. A. Principle of Instrument analysis cengage Learning Indian Indian Ed.
8. Chromatography-H. Kaur.
9. Chemistry for Degree students (B.Sc. First Year): R. L. Madan (S. Chand and company)