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ABEDA INAMDAR SENIOR COLLEGE OF ARTS, SCIENCE, AND COMMERCE (AUTONOMOUS), PUNE – 411 001

POST GRADUATE DEPARTMENT OF CHEMISTRY AND RESEARCH CENTER

Syllabus for

M. Sc. Part – II (Biochemistry)

As per NEP-2020

From Academic Year 2026-2027

Board of Studies (Chemistry)

Post Graduate Department of Chemistry and Research Center

Abeda Inamdar Senior College of Arts, Science and Commerce,

Pune - 411001

Syllabus of Autonomous M. Sc. Part-II Biochemistry
NEP-2020 [w.e.f. 2026-27]

Structure of the Course: Basic Frame work of the syllabus for M. Sc. Part-II Biochemistry under NEP-2020 at the Abeda Inamdar Senior College of Arts, Science and Commerce, (Autonomous), Pune affiliated to Savitribai Phule Pune University, Pune.

Sr. No.	Paper No.	Subject	Credit
SEMEMSTER – III			
1	23SMBC31MM	Techniques in Characterization of Biomolecules	2
2	23SMBC32MM	Medical biochemistry	2
3	23SMBC33MM	Human Physiology	2
4	23SMBC34MM	Immunology	2
5	23SMBC35MM	Forensic Science and Toxicology	2
6	23SMBC36MM	Practical: Immunology and Enzymology	2
7	23SMBC37MM	Practical: Phytochemical Isolation and Analysis	2
		Major Elective: Any One	
8a	23SMBC38MEA	Practical: Molecular Biology and Recombinant DNA Techniques	2
8b	23SMBC38MEB	Practical: Bioinformatics and Molecular Docking	2
		Major Elective: Any One	
9a	23SMBC39MEA	Food Technology	2
9b	23SMBC39MEB	Genetic Engineering	2
10	23SMBC31RP	Research Project	4
SEMESTER – IV			
1	23SMBC41MM	Endocrinology	2
2	23SMBC42MM	Neurobiochemistry	2
3	23SMBC43MM	Cancer Biology	2
4	23SMBC44MM	Pharmaceutical Biochemistry	2
5	23SMBC45MM	Practical: Modern Analytical Techniques	2
6	23SMBC46MM	Practical: Animal and Plant Tissue Culture	2
		Major Elective: Any One	
7a	23SMBC47MEA	Practical: Genomics and Proteomics	2
7b	23SMBC47MEB	Practical: Human Physiology & Medical Biochemistry	2
		Major Elective: Any One	
8a	23SMBC48MEA	Genomics and Proteomics	2
8b	23SMBC48MEB	Drug Discovery and Development	2
9	23SMBC41RP	Research Project	6

*N.B.: 1. One Credit Theory Paper = 15 Hours lectures per semester and 1 Hour per week.
2. Two Credit Practical Paper = 60 Hours practical per semester and 4 hours per week.

M. Sc. II Biochemistry Programme Objectives and Outcomes

Programme Objectives:

1. To develop conscience towards social responsibility, human values and sustainable development through curriculum delivery, laboratory training and extra-curricular activities in Biochemistry.
2. To develop scientific temperament with strong fundamental and applied knowledge of Biochemistry.
3. To develop analytical thinking, problem-solving ability and application skills required for competitive examinations, research and higher education in life sciences.
4. To train students in biochemical laboratory skills, handling of modern analytical and molecular biology instruments along with soft skills required for placement and professional growth.
5. To mold a generation of youth capable of applying biochemical principles in healthcare, industry, research and everyday life.
6. To inculcate scientific attitude enriched with a multidisciplinary perspective integrating chemistry, biology, medicine, biotechnology and computational sciences.
7. To update students with the emerging needs of industry and society with respect to Biochemistry, biotechnology, pharmaceuticals, diagnostics and allied life-science sectors.

Programme Outcomes: After completing the **M. Sc. Programme**, the students shall:

1. Know, understand and explain the basic as well as applied aspects of Biochemistry.
2. Be able to apply biochemical knowledge and laboratory skills in professional, social and personal life.
3. Be competent to analyze biological problems and pursue research or a professional career in Biochemistry and allied fields.
4. Have the knowledge, confidence and preparedness to pursue higher studies and research in Biochemistry and life sciences.
5. Have skills in biochemical, molecular and immunological laboratory techniques along with experience in handling modern analytical instruments.
6. Develop sensitivity towards social, ethical and environmental issues and become productive and responsible citizens of the nation.

Programme Specific Outcome:

M.Sc. Biochemistry:

1. Should gain knowledge and understanding of biomolecules, enzymology, immunology, medical biochemistry, metabolism and molecular biology.

2. Students should be able to apply classical biochemical laboratory techniques and use modern analytical and molecular instrumentation to perform experiments.
3. Should be able to understand and analyze advanced analytical techniques, genomics, proteomics, bioinformatics, molecular docking and tissue culture methods.
4. Should acquire the ability to isolate, estimate, analyze and characterize biomolecules using laboratory and instrumental techniques.
5. Should be able to integrate biochemical knowledge with drug discovery, pharmaceutical biochemistry, toxicology, forensic science and food technology.
6. Learn about the applications of genetic engineering, recombinant DNA technology, cancer biology, endocrinology and neurobiochemistry.
7. Should be able to shoulder responsibilities in research laboratories, diagnostic centers and biotechnology industries.
8. To interpret and evaluate experimental, clinical and molecular data obtained from various biochemical and analytical techniques using theoretical principles.
9. Able to apply biochemical knowledge and problem-solving skills to research-oriented and real-world biological challenges.
10. Should know global-level research opportunities to pursue Ph.D. programmes and targeted preparation strategies for CSIR-NET, GATE and other competitive examinations.
11. Should know enormous job opportunities at various levels in pharmaceutical, biotechnology, food, forensic, clinical diagnostics and life-science industries.

Evaluation Pattern:

For each Theory and Practical Course, **50-50 pattern** will be followed. Internal assessment will be of **50 marks** for a paper of **100 Marks**. Internal assessment will be of **25 marks** for a paper of **50 Marks**.

For **Continuous Internal Evaluation (CIE)**, evaluation of theory courses will be done continuously. The **50 marks of Internal Evaluation** shall be divided into the following:

a) One Mid Semester Exam of **15 Marks**.
b) One / Two Class Tests of **15 Marks** converted to **15 Marks**.
c) One Presentation / Seminar / MCQ Test of **5 Marks**.
d) One Group Discussion / Open Book Test of **5 or 10 Marks**.
e) Class Assignments of **10 or 5 Marks**.
f) A compulsory Mock Practical Examination and Viva-Voce of practical subjects.
g) Internal marks for Journal / Project Report / Dissertation Report completion and certification.

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SEMESTER – III

Course/ Paper Title	**Techniques in Characterization of Biomolecules**
Course Code	**23SMBC31MM**
Semester	III
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. To provide fundamental understanding of viscosity and its role in protein denaturation and molecular weight determination. 2. To explain principles, instrumentation, and applications of IR and NMR spectroscopy. 3. To introduce theory and instrumentation of mass spectrometry including LC-MS and MALDI techniques. 4. To develop knowledge of X-ray diffraction and Ramachandran plot for structural analysis. 5. To familiarize students with measurement of radioactivity and autoradiography.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Apply the concept of viscosity to explain protein denaturation and determine molecular weight. 2. Describe the principles, instrumentation, and applications of IR and NMR spectroscopy. 3. Interpret mass spectral data obtained from LC-MS, MALDI-MS, and MALDI-TOF-MS to deduce molecular information. 4. Analyze molecular structures using X-ray diffraction principles and Ramachandran plots. 5. Evaluate methods for measurement of radioactivity and their applications in autoradiography.

23SMBC31MM: Techniques in Characterization of Biomolecules (30 Hours)

Sr. No.	Name of the Topic	Hours
1.	**Viscosity:** Theory, Factors affecting viscosity, Measurement of viscosity, Applications of viscosity, Protein denaturation and molecular weight determination.	**06**
2.	**Spectroscopic methods:** NMR Spectroscopy- principle, instrumentation and applications; **IR Spectroscopy**, theory and Applications.	**08**
3.	**Mass Spectrometry:** theory, instrumentation, LCMS, MALDI-MS, MALDI-TOF-MS, Applications.	**08**

4.	**X-ray diffraction:** Principle, instrumentation, applications, Ramachandran Plot.	**04**
5.	**Isotope Tracer Techniques:** Types of radiations, types of decay, rate of radioactive decay, half-life, units of radioactivity, Detection and measurement of radioactivity, Radiation dosimetry, Cerenkov counting.	**04**

References:

1. Physical Biochemistry by D. Freifelder IInd Edition Freeman publication (1982).
2. Biochemical techniques by Wilson and Walker, Seventh edition, Cambridge University press (2010).
3. Biophysical techniques by Upadhye and Upadhye, Himalaya Pub. House, (2009).
4. Fundamentals of biochemistry by D. Voet, J. Voet and C.W. Prott, 5th edition, 2016.
5. Biochemical calculation by I.H. Segal IInd Edition

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SEMESTER – III

Course/ Paper Title	**Medical Biochemistry**
Course Code	**23SMBC32MM**
Semester	III
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. To understand cellular chemistry, metabolism, and disease at a molecular level. 2. To teach the principles and applications of analytical techniques, instrumentation, and modern biochemical experimentation. 3. To develop skills in clinical biochemistry, including laboratory methods for diagnosis, monitoring, and understanding disease states. 4. To foster critical thinking, problem-solving, and research-oriented skills for careers in academia, healthcare, and industry.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Develop skills in biochemical testing and interpretation of data for diagnostics. 2. Explain the chemistry and metabolism of biomolecules and how their abnormalities lead to disease. 3. Perform and interpret various biochemical tests, including hormone assays, enzyme assays, and others. 4. Apply biochemical knowledge to advise on diagnostic workups, interpret clinical data, and understand disease management.

23SMBC32MM: Medical Biochemistry (30 Hours)

Sr. No.	Name of the Topic	Hours
1	**Blood Group Systems and Their Clinical Significance:** Composition, ABO and Rh blood group systems, Bombay blood group, applications of blood groups, Disorders of hemoglobin - Thalassemia and sickle cell anemia. Anemias - microcytic, normocytic and macrocytic.	06
2	**Clinical Enzymology and Biomarkers:** Cardiac markers: Creatine kinase, cardiac troponins, lactate dehydrogenase. Liver disease markers: AST, ALT, alkaline phosphatase, 5′-nucleotidase, gamma-glutamyltransferase. Other	06

	diagnostic enzymes: Acid phosphatase, cholinesterase, G6PD, amylase, lipase, aldolase, enolase.	
3	**Vital organ test:** Liver function tests: Serum bilirubin; classification of jaundice; tests of metabolic capacity; synthetic function tests. Gastric function tests: Hydrochloric acid secretion; assessment of free and total acidity. Kidney function tests: Urine formation; tubular functions; renal threshold; tubular maximum; normal and abnormal urine constituents; clearance tests. Numericals: Problems based on the above tests.	14
4	**Inborn Errors of Metabolism:** Phenylketonuria, Alkaptonuria, Albinism, Tyrosinosis, Maple Syrup Urine Disease, Lesch-Nyhan Syndrome, Sickle Cell Anemia, Histidinemia.	04

References:

1. Practical clinical Biochemistry, Harold Varley (4th Edition), CBS publishers and Distributers. New Delhi -110002.
2. Basic Concepts in Clinical Biochemistry: A Practical Guide by Vijay Kumar and Kiran Dip Gill, Springer Nature Singapore Pvt. Ltd. 2018.
3. Textbook of Biochemistry for Medical Students 6th and 7th edition by DM Vasudevan, Sreekumari S and KannanVaidyanathan, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.
4. Medical Biochemistry 2nd edition by N. Mallikarjuna Rao, New Age International (P) Ltd., Publishers, New Delhi
5. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics , 5e by Carl A. Burtis, Edward R. Ashwood and David E. Bruns, Elsevier Health - IN, USA, 2012.
6. Nelson, David L., Albert L. Lehninger, and Michael M. Cox. Lehninger principles of biochemistry. Macmillan, 2008.
7. Bishop, Michael L., Edward P. Fody, and Larry E. Schoeff, eds. Clinical Chemistry: Principles, Techniques, and Correlations. Lippincott Williams & Wilkins, 2013.
8. Sembulingam, K and Sembulingam, P 6th Edition (2010). Essentials of Medical Physiology, 5thedition. Jaypae Brothers (p) ltd, New Delhi.

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SEMESTER – III

Course/ Paper Title	**Human Physiology**
Course Code	**23SMBC33MM**
Semester	III
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. Understand the biochemical basis of human organ system functions. 2. Explore physiological mechanisms of cardiovascular, respiratory, digestive, excretory, and reproductive systems from a biochemical perspective. 3. Correlate metabolic and biochemical changes with common human disorders. 4. Analyze homeostatic mechanisms regulating biochemical pathways in organ systems. 5. Apply physiological and biochemical knowledge to research and clinical studies.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Explain the biochemical mechanisms underlying major organ system functions. 2. Correlate biochemical pathways with cardiovascular, respiratory, digestive, excretory, and reproductive physiology. 3. Identify and understand metabolic disorders from a biochemical perspective. 4. Relate homeostatic regulation to biochemical and physiological processes. 5. Apply neuroendocrine and metabolic concepts in research, diagnostics, and clinical practice.

23SMBC33MM: Human Physiology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	**Cardiovascular and Respiratory Systems:** Anatomy Overview- Heart chambers, valves, myogenic heart, specialized cardiac tissue, Lungs and airways; Physiology & Biochemistry- Cardiac cycle, ECG principles, heart rate and stroke volume regulation; Gas transport (O_2/CO_2), oxygen–hemoglobin dissociation curve; Biochemical modulators of heart and respiration (catecholamines, NO, renin–angiotensin system); Hemoglobinopathies, thalassemias, erythrocyte metabolism disorders	**10**
2	**Digestive System and Metabolic Disorders:** Anatomy Overview- Gastrointestinal tract, liver, pancreas, and accessory glands; Physiology & Biochemistry- Digestion and absorption of carbohydrates, proteins, fats;	**10**

	Energy metabolism and basal metabolic rate (BMR); hormonal regulation of metabolism; Carbohydrate metabolism disorders: diabetes mellitus, hypoglycemia, glycogen storage diseases, galactosemia; Lipid metabolism disorders; ketone body metabolism	
3	**Excretory and Reproductive Systems:** Anatomy Overview- Kidneys, nephron, urinary tract; Male and female reproductive organs; Physiology & Biochemistry- Urine formation and concentration; water, electrolyte, and acid–base balance; Spermatogenesis and oogenesis; hormonal regulation; Renin–angiotensin system; Amino acid and mineral metabolism disorders; Biochemical regulation of reproduction; neuroendocrine control via hypothalamic–pituitary–gonadal axis	**10**

References:

1. Textbook of Medical Physiology (2011) 10th ed., Guyton, A.C. and Hall, J.E., Reed Elseviers India Pvt. Ltd. (New Delhi). ISBN: 978-1-4160-4574-8.
2. Chatterjee A.C (2004) Human Physiology,. Volume I & II.11th Edition Medical agency allied, Calcutta.
3. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T., McGraw Hill International Publications (New York), ISBN: 978-0-07-128366-3.
4. M.M.Muthiah Text book of biochemistry, Lecture notes on human physiology Vol II 1991.
5. William. F. Ganong, (2003) Review of Medical Physiology, 14th Edition, A Lange Medical book.
6. Murray, R.K., Granner, D.K., Mayes and P.A., Rodwell, V.W., (2012) Harper's Biochemistry 29th ed., Lange Medical Books/McGraw Hill. ISBN:978-0-07-176-576-3.4

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SEMESTER – III

Course/ Paper Title	**Immunology**
Course Code	**23SMBC34MM**
Semester	III
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. To provide students with a clear understanding of the immune system, including its components, types of immunity, and mechanisms of defence.
2. To familiarize students with the structure, function, and clinical significance of antigens and antibodies, along with key immunodiagnostic techniques.
3. To introduce students to immunohematology concepts, including inheritance of antigens, vaccines, and their medico-legal and clinical applications.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to –
1. Understand the components and functions of the immune system and the different types of immunity.
2. Apply antigen-antibody principles and perform basic immunodiagnostic techniques.
3. Understand vaccine mechanisms and explain their clinical and medico-legal significance.

23SMBC34MM: Immunology (30 Hours)

Sr. No.	Name of the Topic	Hours
1.	**Immune System:** Immunity – Definition & Classification of Immunity- Innate & Acquired Immunity, Active and passive immunity, Humoral & cell mediated Immunity; Three lines of defence mechanisms; Cells of Immune system: Hematopoiesis; lymphoid Organs (primary and secondary) – location, classification & functions of -Bone Marrow, Thymus, Lymph Node, Spleen	**05**
2.	**Antigen and Antibodies:** Antigen - Definition, concept of immunogen, epitopes, types of antigens- soluble and particulate antigens, autoantigens, Isoantigens, factors affecting immunogenicity. Concepts of haptens, carriers and adjuvants; Antibodies/Immunoglobulin - Definition, structure of typical immunoglobulin, classes and biological functions of immunoglobulin	**05**

3.	**Immunodiagnostic techniques:** Principles of Antigen-Antibody Interactions-Lattice Hypothesis, Zone Phenomenon; **Antigen-Antibody Reaction Techniques** (Principle, Instrumentation, and Working)- Precipitation, Agglutination, Immunofluorescence, ELISA (Enzyme-Linked Immunosorbent Assay), Radioimmunoassay (RIA), Chemiluminescence Immunoassay (CLIA), Western Blotting Technique, Complement Fixation Test (CFT)	**13**
4.	**Vaccines:** Mechanism- Active and passive immunization, Live, killed, attenuated, sub unit vaccines; Recombinant Vaccines, Polyvalent vaccines, DNA vaccines	**07**

References:

1. Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kuby, J. (2013). Kuby immunology (7th ed.). W.H. Freeman.
2. Ananthanarayan, R., & Paniker, C. K. J. (2019). Textbook of microbiology (10th ed.). Universities Press.
3. Turgeon, M. L. (2016). Immunology and serology in laboratory medicine (6th ed.). Elsevier.
4. Ajmani, P. S. (2019). Immunohematology and blood banking: Principles and practice. Springer.
5. Howard, P. R., & Hicks, W. (2018). Basic and applied concepts of blood banking and transfusion practices (6th ed.). Elsevier
6. Murphy, K., Weaver, C., & Berg, L. (2016). Janeway's immunobiology (9th ed.). Garland Science.
7. Plotkin, S. A., Orenstein, W. A., Offit, P. A., & Edwards, K. M. (2018). Plotkin's vaccines (7th ed.). Elsevier.

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SEMESTER – III

Course/ Paper Title	**Forensic Science and Toxicology**
Course Code	**23SMBC35MM**
Semester	III
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. Understand forensic drugs, poisons, and their significance in medico-legal investigations.
2. Identify and classify drugs, poisons, and controlled substances.
3. Learn extraction, isolation, and analytical techniques for toxic substances.
4. Understand forensic pharmacology and molecular analysis techniques.
5. Prepare and interpret forensic toxicity reports for legal purposes.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to –
1. Explain the types, effects, and hazards of drugs and poisons.
2. Apply extraction, isolation, and analytical methods to biological and environmental samples for forensic analysis.
3. Prepare forensic reports and interpret molecular and pharmacological evidence for legal and investigative purposes.

23SMBC35MM: Forensic Science and Toxicology (30 Hours)

Sr. No.	Name of the Topic	Hours
1.	**Forensic Drugs and Controlled Substances:** Introduction to forensic drugs, their significance, and classification; Origin of drugs- narcotics, natural drugs, synthetic drugs, and psychotropic (mind-altering) drugs; Dependence and addiction-physical and psychological aspects, hazards of drug abuse. Structural relationships, analogs, designer drugs, and isomers; Controlled substances- legal framework, Controlled Substances Act, schedules I–V, charges and offenses, submission to crime laboratories, usable quantities, and court testimony **Chemical screening and microcrystal tests:** principles, chemistry of color formation, limitations, and documentation; Important chemical color tests-	**10**

	Chen's, Dille–Koppanyi, Mecke, Marquis, Nitric Acid, Primary/Secondary/Tertiary Amine, Van-Urk, Duquenois–Levine, Froehde, Janovsky, and Weber tests; Microcrystal techniques: principles, advantages, limitations, aqueous, volatility, and acid/anionic test methods	
2.	**Forensic Toxicology and Poisons:** Introduction to forensic toxicology, definitions, and types of poisons. Signs, symptoms, mode of action, and factors affecting toxicity; Preservation of toxicological exhibits in fatal and survival cases; Slow poisoning: detection, reporting, treatment, and preparation of toxicity reports; Plant-based poisons- Opium, Abrus, Dhatura, Nux-vomica, Oleander, Marking nuts, and Cyanogenetic glycosides **Extraction, isolation, and analysis of poisons:** Non-volatile poisons (Stas-Otto, Dovbriey–Nickolls, acid digestion, Valov/Tungstate, solid-phase microextraction, solvent extraction), volatile poisons (industrial solvents, acid/base distillation), toxic cations (dry ashing, wet digestion), and toxic anions (dialysis, total alcoholic extract); Analysis of drugs and chemicals-barbiturates, methaqualone, hydromorphone, methadone, meprobamate, mescaline, amphetamines, LSD, heroin, cannabinoids, phenothiazines; Insecticides and alkaloids- classification, isolation, and characterization	**10**
3.	**Metals, Alcohols, Molecular Analysis, and Forensic Pharmacology:** Forensic examination of metallic poisons- arsenic, mercury, lead, bismuth, copper, aluminum, iron, barium, zinc; Analysis of ethyl alcohol in blood, urine, and illicit liquor; methanol, acetone, chloroform, phenol; Snake venoms, other poisons, and irrespirable gases. Forensic pharmacology-absorption, distribution, metabolism, and drug pathways; Molecular analysis in forensic science-RFLP for crime detection, Ames test for mutation analysis; Sodium micro glutamate.	**10**

References:

1. Textbook of Forensic Pharmacy, C. K. Kokate, S. B. Ghokhale, Pharma Med Press (2008)
2. Textbook of Forensic Pharmacy, B. M. Miital, Nirali Publication
3. Basic Principles of Forensic Chemistry, Javed I. Khan, Thomas J. Kennedy, Donnell R. Christian, Jr. Humana Press
4. Analysis of Controlled Substances, Michael D. Cole, Wiley (2003)
5. Houck, M. M. (2018). Forensic Toxicology (1st Ed.), United States, Academic Press.
6. Lappas, N. and Lappas, C. (2021). Forensic Toxicology: Principles and Concepts (2nd Ed.), United States, Academic Press.
7. Singh, S. P (2021). Forensic Toxicology (1st Ed.), India, Selective and Scientific Books (SSB).
8. https://journalofhospitalpharmacy.in/johp/admin/freePDF/c4pik8lgixdbknaci830.pdf
9. https://japi.org/article/files/understanding_forensic_pharmacology_what_indian_physicians_need_to_know.pdf

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SEMESTER – III

Course/ Paper Title	**Practical: Enzymology and Immunology**
Course Code	**23SMBC36MM**
Semester	III
No. of Credits	2 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives
1. To introduce fundamental immunological techniques used in clinical and diagnostic laboratories. 2. To develop practical skills in blood grouping, agglutination, immunochromatographic, and immunoprecipitation tests. 3. To familiarize students with immunohematological procedures such as cross-matching and Coomb's tests. 4. To provide hands-on training in enzyme isolation, identification, and activity determination from natural sources. 5. To understand enzyme kinetics and factors affecting enzyme activity including pH, temperature, substrate concentration, and activation energy.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Perform and interpret basic serological tests such as Widal and RPR. 2. Apply antigen–antibody principles in agglutination, inhibition, immunochromatography, and immunodiffusion techniques. 3. Carry out immunohematology procedures, including cross-matching and direct/indirect Coomb's tests. 4. Isolate, identify, and estimate the activity and specific activity of enzymes from biological sources. 5. Analyze enzyme kinetics by determining Km, Vmax, and activation energy, and evaluate the effects of pH and temperature on enzyme catalysis.

23SMBC36MM: Practical: Enzymology and Immunology (60 Hours)

Sr. No.	**Name of the Topic**
	Perform minimum 12 Experiments from the following -

	Section A-Enzymology
1.	Identification of enzymes in different sources
2.	Isolation and identification of common enzymes from natural source (invertase/amylase/peroxidase/catalase)
3.	Determination of enzyme activity
4.	Effect of pH on enzyme activity.
5.	Effect of temperature on enzyme activity.
6.	Determination of specific activity of enzyme
7.	Determination of K_m and V_{max} of enzyme catalysis
8.	Determination of activation energy of acid phosphatase
9.	Effect of amylase activity on starch
	Section B-Immunology
10.	Agglutination tests: Widal test (Slide test and Tube Test)
11.	Rapid Plasma Reagin (RPR) test
12.	Precipitation test: radial immunodiffusion test, Ouchterlony immunodiffusion
13.	White blood cell differential count from peripheral blood
14.	Immunohematology: Cross-matching (Major and Minor)
15.	Coomb's test (Direct and Indirect)
16.	Immunochromatography tests: a) Qualitative differential detection of IgM and IgG antibodies to Dengue virus in human serum / plasma b) Qualitative detection of Rheumatoid factor (RA factor)
17.	Latex Agglutination test
18.	ELISA, RIA demonstration.
19.	Western Blotting

References:

1. Practical Manual of Biochemistry first edition by Sattanathan, Padmapriya and Balamuralikrishnan, Skyfox Publishing Group.
2. Biochemical Tests principle and protocols by Anil Kumar, Sarika Garg and Neha Garg, Viva publication.
3. Biochemical Methods by S. Sadasivam and A manickam, third edition, New Age international Publication.

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SEMESTER – III

Course/ Paper Title	**Practical: Phytochemical Isolation and Analysis**
Course Code	**23SMBC37MM**
Semester	III
No. of Credits	2 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives
1. To introduce students to fundamental concepts of phytochemistry and natural product chemistry. 2. To provide practical exposure to extraction, isolation, and separation of plant-derived compounds. 3. To develop skills in qualitative and quantitative analysis of primary and secondary metabolites. 4. To train students in the application of chromatographic and spectrophotometric techniques. 5. To familiarize students with bioactivity screening of plant-based extracts.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Perform extraction and isolation of phytochemicals from medicinal and local plant sources. 2. Identify primary and secondary metabolites using standard qualitative tests. 3. Quantitatively estimate important plant metabolites using spectrophotometric methods. 4. Apply chromatographic techniques for separation and profiling of natural products. 5. Evaluate the antioxidant potential of herbal extracts using in vitro assays.

23SMBC37MM: Practical: Phytochemical Isolation and Analysis (60 Hours)

Sr. No.	**Name of the Topic**
	Perform minimum 12 Experiments from the following -
	Section A-Extraction and Isolation Techniques
1.	Isolation of a Phytochemical from a Selected Medicinal Plant
2.	Isolation of a Phytochemical from a Local Plant
3.	Isolation of Water-Soluble Natural Pigments from Flower Material
4.	Isolation of Fat-Soluble Natural Pigments from Flower Material
5.	Isolation of Essential Oil from Plant Leaves
6.	Separation and Purification of Natural Products by Column Chromatography
	Section B-Qualitative Phytochemical Analysis

7.	Qualitative Analysis of Primary Metabolites
8.	Qualitative Analysis of Secondary Metabolites (Alkaloids, tannins, phenols)
9.	Qualitative Analysis of Secondary Metabolites (Flavonoids, saponins, terpenoids, glycosides)
10.	Qualitative Analysis of Vitamins
	Section C-Quantitative Estimation of Plant Metabolites
11.	Estimation of Total Phenolic Content
12.	Estimation of Total Flavonoids
13.	Estimation of Tannins
14.	Estimation of Chlorophyll
	Section D- Spectrophotometric and Bioactivity Assays
15.	Spectrophotometric Estimation of Indole-3-Acetic Acid (IAA) in Plant Tissues.
16.	Estimation of Ascorbic Acid from natural source
17.	Screening of Herbal Extracts for Antioxidant Activity (DPPH free radical scavenging assay)
18.	Screening of Herbal Extracts for Antioxidant Activity (ABTS / Reducing power assay)

References:

1. Jayaraman, J.,(2011). Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi.
2. Sadasivam, S., and Manickam, A., (2009). Biochemical Methods, New Age, International Publishers, New Delhi.
3. Singh, S.P.,(2009). Practical Manual of Biochemistry, CBS Publishers, New Delhi.
4. David, T. Plummer, (1988). An Introduction to Practical Biochemistry. 3rd Edition. Tata McGraw Hill Publishing Company Ltd. New Delhi.
5. Pattabiraman, T.N. (1998). Laboratory Manual in Biochemistry. 3rd Edition. All India Publishers and Distributors. Chennai.
6. Wagner,H., and Bladt,S., (1996). Plant drug analysis. Springer Science & Business media 2nd edition

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SEMESTER – III

Course/ Paper Title	Practical: Molecular Biology and Recombinant DNA Techniques
Course Code	23SMBC38MEA
Semester	III
No. of Credits	2 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives
1. To provide hands-on training in molecular biology and recombinant DNA techniques. 2. To develop skills in isolation and purification of DNA and RNA from different sources. 3. To enable students to analyze nucleic acids and proteins using spectrophotometry and electrophoresis. 4. To familiarize students with recombinant DNA methods: plasmid handling, restriction digestion, ligation, and transformation. 5. To introduce basic bioinformatics tools for primer design and restriction mapping.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Isolate and quantify DNA and RNA from bacterial, plant, yeast, and mammalian samples. 2. Perform agarose gel electrophoresis and determine nucleic acid molecular size. 3. Carry out recombinant DNA techniques, including plasmid isolation, restriction digestion, ligation, and transformation. 4. Demonstrate gene transfer mechanisms, including transformation, transduction, and conjugation. 5. Apply PCR and bioinformatics tools for gene amplification and primer design.

23SMBC38MEA: Practical: Molecular Biology and Recombinant DNA Techniques (60 Hours)

Sr. No.	Name of the Topic
	Perform minimum 12 Experiments from the following -
1.	Isolation of DNA from bacterial / plant / liver / yeast source
2.	Isolation of RNA from bacterial / plant / yeast / mammalian source
3.	Spectrophotometric analysis of nucleic acids (DNA & RNA)

4.	Determination of melting temperature of DNA
5.	Agarose gel electrophoresis of DNA and molecular size determination
6.	Isolation and purification of plasmid DNA
7.	Restriction digestion analysis of DNA
8.	Ligation study of DNA fragments
9.	Polymerase Chain Reaction (PCR) for DNA amplification
10.	Analysis of PCR products by agarose gel electrophoresis
11.	Preparation of competent bacterial cells
12.	Transformation of bacteria with plasmid DNA
13.	Transduction in bacteria
14.	Conjugation and analysis of bacterial gene expression
15.	Restriction map analysis and primer designing (*in silico*)

References:

1. Brown, T.A. (2006). Gene Cloning and DNA Analysis (5th ed.). Oxford: UK, Blackwell Publishing.
2. Primrose, S.B., & Twyman, R.M. (2006). Principles of Gene Manipulation and Genomics (7th ed.). Oxford: UK, Blackwell Publishing.
3. 3. Sambrook, J., Fritsch, E.F., & Maniatis, T. (2001). Molecular Cloning-A Laboratory Manual. (3rd ed.). Cold Spring Harbor Laboratory Press.

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SEMESTER – III

Course/ Paper Title	**Practical: Bioinformatics and Molecular Docking**
Course Code	**23SMBC38MEB**
Semester	III
No. of Credits	2 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives
1. To equip students with the skills needed for computer-assisted drug discovery, covering the analysis of biological data and the simulation of protein-ligand interactions 2. Introduce the principles of bioinformatics, structural molecular biology, and the fundamentals of computer-aided drug design (CADD). 3. Train students in homology modeling to predict 3D structures of proteins from sequences. 4. Provide in-depth knowledge on molecular docking, including identifying binding sites and predicting binding modes (binding free energy).

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Perform sequence alignment, phylogenetic analysis, and gene/protein structure prediction. 2. Successfully prepare receptor and ligand files, run docking simulations, and analyze interactions (hydrogen bonds, hydrophobic interactions). 3. Apply structure-based drug design (SBDD) strategies to develop more potent and selective drug candidates. 4. Understand the information's available in Bioinformatics databases and their applications in research.

23SMBC38MEB: Practical: Bioinformatics and Molecular Docking (60 Hours)

Sr. No.	Name of the Topic
	Perform minimum 12 Experiments from the following -
1.	Primer design using bioinformatic tools.
2.	Analysis of gene expression using bioinformatics tools.
3.	DNA sequence analysis to find restriction enzymes sites using NEB cutter.
4.	To find an Open Reading Frame (ORF) for a gene using bioinformatics tools.
5.	*In Silico*-Prediction of toxicity of the drugs.
6.	Protein and ligand preparation for molecular docking.

7.	Protein visualization using pyMol, MGLTools, Discovery studio, PDB and online tools.
8.	Determination of Hammett constant of meta and para amino/nitro benzoic acid by pH measurement
9.	Applying the Hammett Equation to a Series of Substituted Benzoic Acids. (Table work)
10.	To perform Molecular Docking.
11.	Spectroscopic investigation of partition coefficient of iodine between H_2O and $CHCl_3$.
12.	To determine the partition coefficient of Succinic acid between benzene and water.
13.	Development of a QSAR Model Using PaDEL-Descriptor.
14.	Application of Hansch Analysis to Study Structure–Activity Relationships of Drug Molecules.
15.	Correlation of LogP and Biological Activity Using Hansch Analysis.
16.	Performing molecular orbital calculations using ArgusLab.
17.	To do homology modeling of protein using *in silico* methods.
18.	To Predict activity spectrum for small molecules using PASS tool.
19.	To plot the Ramachandran Plot.
20.	Calculation and Graphical Analysis of *In Vitro* Cytotoxicity Parameters (IC_{50}, GI_{50} and Selectivity Index).

References:

1. Practical Human Anatomy and Physiology for Pharmacy Students, 2nd Edition by Nitin Ashok John, CBS Publishers & Distributors Pvt. Ltd. New Delhi.
2. Physiology Practical Manual by Rashmi Ramanathan, Elsevier; Special Edition, CBSPD.
3. Manual of Practical Physiology, 7th Edition by A. K. Jain, Arya Publishing Company, New Delhi.
4. A Textbook of Practical Physiology 8th Edition by C. L. Ghai, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.
5. Modern Experimental Biochemistry, 3rd Edition, by Rodney Boyer, published by Pearson Education Inc (Singapore).
6. Any other suitable reference can be included and used.

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SEMESTER – III

Course/ Paper Title	**Food Technology**
Course Code	**23SMBC39MEA**
Semester	III
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. To Understand Foods proximate compositions and their nutritional significance.
2. To Understand Proteins concentrates and hydrolysates, unconventional sources- OCP, SCP etc.
3. To Understand Starches and Sugars: production, uses, and sweeteners.
4. To Understand the effects of Food processing and role of enzymes in food technology.
5. To Understand Food safety, additives, adulteration, and quality control standards.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to –
1. Explain foods' proximate compositions and their applications.
2. Describe protein concentrates, hydrolysates, and unconventional protein sources.
3. Describe starches and sugars, including their production and uses.
4. Analyse the effects of food processing and enzymatic applications on food quality.
5. Evaluate food safety, additives, adulteration, and quality control standards.

23SMBC39MEA: Food Technology (30 Hours)

Sr. No.	Name of the Topic	Hours
1.	**Foods, Proteins, and Sugars:** Foods proximate compositions; Proteins concentrates and hydrolysates, unconventional sources- OCP, SCP etc.; Starches and Sugars- starch production and uses, manufacture of natural and synthetic sweeteners and syrups	**12**
2.	**Food Processing and Enzymes:** Effect of Food processing- Sprouting, fermentation, heat processing, irradiation; Enzymes in food processing, meat tenderization and fruit juice technology	**10**
3.	**Food Safety and Quality:** Food safety: Biochemistry of food spoilage and	**08**

	preservations; Food additives, flavoring agents and colors; Food Adulteration and Food quality control standards monitoring agencies	

References:

1. Enzymes and food processing- GG Birch, N Blackbrough (1981).
2. Nutrition and food processing- MG Miller, G Tobin, AVI publishing Co, Creem Holm (1980).
3. Introduction to food sciences and technology –GF Stewart and MA Amerine 2nd edition (1973) Academic Press.

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SEMESTER – III

Course/ Paper Title	**Genetic Engineering**
Course Code	**23SMBC39MEB**
Semester	III
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. To understand the principles and tools of recombinant DNA technology.
2. To study cloning vectors and genomic library construction.
3. To understand gene silencing and recombinant DNA applications.
4. To learn transgenic technology and gene transfer systems.
5. To understand applications and ethical aspects of genetic engineering.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to –
1. Explain recombinant DNA technology and its mechanism.
2. Describe cloning vectors and their genomic applications.
3. Understand gene silencing technologies and their applications.
4. Explain transgenic technology and genetic engineering techniques.
5. Evaluate the applications and ethical considerations of genetic engineering.

23SMBC39MEB: Genetic Engineering (30 Hours)

Sr. No.	Name of the Topic	Hours
1.	**Recombinant DNA Technology and Cloning Vectors:** Restriction enzymes and their types, restriction–modification system, DNA ligase, RNA and DNA polymerases; Molecular vectors including plasmids, phage vectors, shuttle vectors, and cosmids; High-capacity cloning vectors such as YACs, BACs, and PACs; Mechanism of recombinant DNA technology	09
2.	**Genomic Applications and Gene Silencing:** Genomic and recombinant DNA therapy; Methods for construction of genomic and cDNA libraries including vectors used, generation of cDNAs, and preparation of genomic DNA for library construction; Methods used in the identification and analysis of recombinant DNA clones; Protein–protein interaction and yeast two-hybrid system; Introduction to siRNA and microRNA, siRNA technology,	09

	construction of siRNA vectors, principles and applications of gene silencing; Production of insulin, drugs, vaccines, and diagnostic probes for genetic diseases; Gene therapy; Polymerase chain reaction (PCR) in recombinant DNA technology and chromosome walking	
3.	**Transgenic Technology:** Transgenic technology including gene knockout and knock-in, generation of transgenic animals and their applications, and Cre–loxP recombination technology; Homologous and non-homologous recombination, gene isolation, and gene transfer systems; Ti plasmid and plant virus vectors; Methods of gene transfer including electroporation, microinjection, microprojectile technology, and particle bombardment; Generation of transgenic plants and animals and their applications, somatic embryogenesis, and embryo rescue; Applications of recombinant DNA technology in photosynthetic efficiency, nitrogen fixation efficiency, and resistance to environmental stresses	**06**
4.	**Techniques and Applications of Genetic Engineering:** Techniques in genetic engineering including molecular genetic maps-restriction mapping, restriction fragment length polymorphisms (RFLP), linkage and recombination between molecular and phenotypic markers, and random amplified polymorphic DNA (RAPD) using PCR; Sequencing of nucleic acids by Maxam–Gilbert chemical degradation and Sanger's dideoxy chain termination methods; Cloning of specific genes and their expression in bacterial and eukaryotic systems; Human Genome Project and microarray technology; Applications of genetic engineering in medicine, agriculture, and industry; Social and moral implications and national and international guidelines and regulations	**06**

References:

1. Recombinant DNA – James D Watson et al.
2. Gene Cloning – T. A. Brown.
3. From Genes to Genomes – J.W. Dala and Schantz
4. Gene Biotechnology – S.N. Jogdand
5. Medical Biotechnology - S.N. Jogdand
6. Principles of gene manipulations – R. W. Old and S.B. Primerose
7. Genes – Lewin B.
8. PCR-Technology: Principles and application of DNA amplification – H.A. Erlich.

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SEMESTER – III

Course/ Paper Title	**Research Project**
Course Code	**23SMBC31RP**
Semester	III
No. of Credits	4 Credits, (120 Hours)

Aims & Objectives of the Course

Objectives
1. To provide hands-on research training in Biochemistry and allied interdisciplinary areas. 2. To enable students to identify and formulate research problems with a clear Biochemistry component. 3. To develop skills in designing and performing biochemical experiments using interdisciplinary approaches. 4. To enhance abilities in data analysis, interpretation, and critical evaluation of scientific literature from multiple disciplines. 5. To inculcate good research practices, documentation skills, and research ethics in academic and industrial research settings.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Plan and execute a biochemistry-based research project incorporating interdisciplinary concepts. 2. Apply appropriate biochemical and allied techniques for experimental work and data generation. 3. Analyze and interpret experimental results by integrating knowledge from related disciplines. 4. Maintain systematic and accurate records of interdisciplinary research activities and progress. 5. Communicate research findings effectively in oral and written forms to specialized and interdisciplinary audiences.

23SMBC31RP: Research Project (120 Hours)

The Research Project is a mandatory component of the MSc Biochemistry programme and shall be carried out during the **Third and Fourth Semesters**. The project work may be undertaken in the **Department, Research Institutes, Industries, or other National / International Organizations**.

Project Guidance

- For projects conducted within the Department, a faculty member shall serve as the Guide.
- For projects conducted outside the Department:
  - One faculty member from the Department shall be appointed as Co-guide / Internal Mentor.
  - The teacher or scientist at the host organization shall act as the External Guide.
- An attendance certificate from the host organization, duly signed by the guide, shall be submitted.

Nature and Scope of the Project

1. The project shall be Biochemistry-oriented, emphasizing experimental or applied research.
2. Interdisciplinary projects are encouraged, provided a clearly defined Biochemistry component is included.
3. Students shall dedicate a minimum of four hours per week to project work.

Monitoring and Documentation

4. In the case of external projects, the Internal Mentor shall be responsible for internal assessment.
5. A systematic attendance record of the student shall be maintained by the mentor/guide.
6. Students shall submit monthly progress reports to the guide/co-guide/mentor, supported by geotagged photographs, at the time of examination.
7. A Daily Project Work Diary shall be maintained by the student and reviewed weekly by the mentor/guide.

Progress Evaluation and Examination

8. If adequate experimental work is not completed during the Third Semester, the student shall carry out a comprehensive literature survey and present relevant research papers in the form of a review presentation, along with the completed work.
9. The Third Semester project progression shall be evaluated jointly by all examiners. The student shall present experimental work, results, challenges, and records (15–20 minutes), followed by a question–answer session (10 minutes). The examination shall be of an open type.

Project Report Submission

Students shall submit **complete copies of the Project Report** to the **Department and Project Guide** at the time of examination. The report must follow the **scientific format**:

1. **Certificate** – Signed by Project Guide and Head of Department
2. **Certificates of Poster / Paper Presentation** – If applicable
3. **Self-Declaration Certificate for Plagiarism**
4. **Introduction** – Max six pages; including background, rationale, objectives, and scope
5. **Experimental Section** – Materials, methods, biochemical and interdisciplinary techniques
6. **Results and Discussion** – Data presentation, analysis, interpretation, and comparison with literature
7. **Conclusion** – Summary of findings and significance

8. **References** – Cited strictly in **ACS format**
9. **Supporting Data** – Spectroscopic, biochemical assays, graphs, images, or other relevant data
10. **Acknowledgements**

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SEMESTER – IV

Course/ Paper Title	**Endocrinology**
Course Code	**23SMBC41MM**
Semester	IV
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. Understand the chemical nature, biosynthesis, and mechanisms of action of hormones. 2. Learn regulation and physiological roles of major endocrine hormones. 3. Correlate hormone structure with physiological function. 4. Recognize endocrine disorders and their biochemical basis. 5. Prepare for advanced studies in biochemical or clinical endocrinology.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Describe chemical structure and biosynthesis of major hormones. 2. Explain hormone mechanisms of action using biochemical principles. 3. Correlate chemical structure with physiological function. 4. Identify endocrine disorders and understand their biochemical basis. 5. Apply hormone chemistry knowledge to research or clinical studies.

23SMBC41MM: Endocrinology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	**Endocrine Glands and Pituitary Hormones:** Organization of the endocrine system, General features and classification of hormones-chemistry, biosynthesis, secretion, mechanism of action, and physiological functions; Pituitary hormones-anterior and posterior - regulation, secretion, and disorders; Hypothalamic hormones- structure, secretion, and function; Pineal gland hormones-serotonin and melatonin	10
2	**Thyroid, Parathyroid, Pancreatic, and Gastrointestinal Hormones:** Thyroid hormones- chemistry, biosynthesis, secretion, physiological function, and regulation; Disorders-hypo and hyperthyroidism; tests for thyroid function; Parathyroid hormones-parathormone and calcitonin -	10

	roles in calcium and phosphate metabolism; vitamin D and bone/teeth metabolism; Pancreatic hormones- insulin and glucagon-chemistry, biosynthesis, secretion, regulation, and physiological functions; Gastrointestinal hormones- gastrin, secretin, cholecystokinin; Role of insulin and glucagon in carbohydrate, lipid, and protein metabolism	
3	**Adrenal and Reproductive Hormones:** Adrenal hormones: medullary and cortical- chemistry, biosynthesis, functions, and disorders; simple evaluation tests; Gametogenesis- spermatogenesis and oogenesis; Gonadal hormones: androgens, estrogens, progesterone - chemistry, biosynthesis, and physiological functions; Hormonal regulation of menstrual cycle, contraception, and reproductive disorders	**10**

References:

1. Textbook of Physiology, Guyton, 12th edition (2010).
2. Biochemistry, Zubay, Addison Wesley and Co. (1983).
3. Vertebrate endocrinology- Noris DO 5th ed (2013).
4. Endocrine physiology- Martin, CR (1985(Oxford Univ press (NY).
5. Biochemistry- Zubay (1983) Addison, Wesley publ. Co.
6. Text book of endocrinology –Williams, 13th edition Saundes Co (2016). 8. Biochemical endocrinology E. Frieden (1983).
7. General Endocrinology – Turner.
8. Biochemical Endocrinology of the Vertebrates – E. Fruden and H. Lines.

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SEMESTER – IV

Course/ Paper Title	**Neurobiochemistry**
Course Code	23SMBC42MM
Semester	IV
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. Understand CNS and PNS structure from a biochemical perspective.
2. Learn the biochemical pathways of neurotransmitter metabolism and signaling.
3. Study receptor-mediated signal transduction and sensory circuits.
4. Explore biochemical mechanisms of learning, memory, and circadian rhythms.
5. Correlate biochemical alterations with neurological disorders.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to –
1. Describe CNS and PNS structures with emphasis on biochemical functions.
2. Explain neurotransmitter metabolism, receptors, and signaling pathways.
3. Correlate neuronal biochemical signaling with behavior, learning, and memory.
4. Understand biochemical basis of neurological and neurodegenerative disorders.
5. Apply neurobiochemical knowledge to research, diagnostics, and therapeutic approaches.

23SMBC42MM: Neurobiochemistry (30 Hours)

Sr. No.	Name of the Topic	Hours
1	**Central and Peripheral Nervous System:** Anatomical organization of brain and spinal cord, Constituents of CNS- major brain regions and spinal cord; Blood–brain barrier (BBB)- structure, biochemical role, and significance; Cerebrospinal fluid (CSF)- composition, metabolic aspects, and abnormal constituents; Peripheral nervous system (PNS)- afferent and efferent pathways, Biochemical correlation between brain regions, neurons, and behavior, Functions of brain and nerve cells with respect to metabolism and signaling	10
2	**Neurotransmitters and Receptors:** Major neurotransmitters- acetylcholine, GABA, serotonin, dopamine, glutamate, aspartate, nitric oxide; Neuropeptides- endorphins, enkephalins, substance P, Biochemistry of neurotransmitter synthesis, storage, uptake, degradation, and mechanism of action; Receptors- classification based on ligand and location;	10

	biochemical signaling pathways; Sensory receptors- types, biochemical properties, sensory modalities, and signaling circuits	
3	**Neural Functions, Rhythms, and Disorders:** Learning and memory- biochemical basis of short-term memory, long-term potentiation (LTP); Key receptors and signaling molecules- NMDA, AMPA, Ca^{2+}, CAM kinase II, protein kinases, cAMP, cGMP, Retrograde messengers and intracellular biochemical pathways; Circadian rhythms- biochemical mechanisms in sleep–wake cycles and neurotransmitter regulation; Nervous system disorders- biochemical basis of brain (aphasia, Wernicke's syndrome), spinal cord (meningitis, sclerosis), sensory/motor neuropathies; Neurodegenerative diseases- Parkinson's, Alzheimer's, dementia- biochemical alterations, Hallucinations and hallucinogens: biochemical effects, Biochemical basis of diagnosis, prevention, and treatment of nervous system disorders	**10**

References:

1. George I. Siegel, 2000. Basic Neurochemistry. [Seventh Edition]. Academic Press, New Delhi.
2. Kathleen J. W. Wilson and Anne Waugh. 1998. Anatomy and Physiology in Health and Illness. [Eighth Edition]. Churchchill Livingstone, New York.
3. Gerard J Tortora and Bryan derrickson Principles of anatomy and physiology, 14th Edition.
4. Gerald. J. Tortora and Sandra Reynolds. 2003. Principles of Anatomy and Physiology. [Tenth Edition]. John Wiley and Sons. Inc. Pub. New York.
5. Tripathi, K. D. 1999. Essentials of Medical Pharmacology. [Fourth Edition]. Jaypee Brothers Medical Publishers. New Dehli.
6. Principles of neural science Kandel ER, Schwartz JH, Elsevier, N.Holland.

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SEMESTER – IV

Course/ Paper Title	**Cancer Biology**
Course Code	**23SMBC43MM**
Semester	IV
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. To introduce the concept of cancer biology.
2. To inculcate the knowledge of causes, types and various stages of cancer.
3. To make students familiar with the basic knowledge of mutations involved in cancer.
4. To make students understand the diagnosis and treatment of cancer.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to –
1. Understand the properties of normal and cancer cells.
2. Describe the types and stages of cancer.
3. Identify the challenges faced by current cancer therapies.

23SMBC43MM: Cancer Biology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	**Introduction to cancer:** Definition of cancer and causes of cancer, universal properties of normal cell, properties of cancer cell, benign tumor vs malignant tumor, types of cancer, various stages of cancer, definition of primary and secondary cancer with examples	09
2	**Types of mutations involved in cancer:** Loss of function, gain of function and frame-shift mutations mutations involved in cancer, role of tumor suppressor genes and proto-oncogenes (p53) in cancer	09
3	**Cancer classification:** TNM classification- Purpose and types of staging and factors affecting the staging system	05
4	**Cancer diagnosis and treatment:** Clinical examination, radiological examination, biopsy and it's types, radiotherapy, chemotherapy, monoclonal antibodies used for treatment of cancer	07

References:

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, Molecular biology of the Cell, WW Norton & Co, ISBN-13 : 978-0393884852, 7th Edition, July 2022 .
2. Lodish, Harvey; Berk, Arnold; Matsudaira, Paul; Kaiser, Molecular Cell Biology, W.H.Freeman & Co Ltd, ISBN-13 : 978-0716743668, 5th revised edition, August 2003.
3. Gerald Carp, Cell biology, Wiley Publishers, ISBN-13 : 978-1118318744, 7th edition, May 2013.
4. David Nelson & Michael Cox, -Lehninger, Principles of Biochemistry, W.H. Freeman and company, NY, ISBN-13: 978-1319108243 ISBN-10: 9781319108243, 5th Edition, January 2017.
5. Lewis J. Kleinsmith, Principles of Cancer Biology, Pearson Education India, ISBN-13 978-9332577480, First Edition, 29 July 2016.
6. Robin Hesketh, Introduction to Cancer Biology, Cambridge University Press, ISBN-13 97813165126162023, revised edition, 2023.

E- Resources

1. https://www.sciencedirect.com/science/article/pii/S2311300617300125
2. https://pmc.ncbi.nlm.nih.gov/articles/PMC5696686/
3. https://pmc.ncbi.nlm.nih.gov/articles/PMC9012285/
4. https://www.pnas.org/doi/10.1073/pnas.0334858100
5. https://www.sciencedirect.com/science/article/pii/S1773224724002685

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SEMESTER – IV

Course/ Paper Title	**Pharmaceutical Biochemistry**
Course Code	**23SMBC44MM**
Semester	IV
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. The basic ideas of drug development and discovery. 2. To learn about the drug with regard to pharmacodynamics and pharmacokinetic aspects. 3. To provide students with an in-depth understanding of the principles and practice of chemotherapy 4. To classify chemotherapeutic agents based on their target microorganism, mechanism of action, and chemical structure.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Do Drug screening, target identification, lead discovery and optimization. 2. Explain how drugs interact with biological systems at a molecular level. 3. Explain Drug absorption, distribution, metabolism, excretion, and dosage optimization. 4. Apply knowledge to interpret results and understand pharmaceutical formulations.

23SMBC44M: Pharmaceutical Biochemistry (30 Hours)

Sr. No.	Name of the Topic	Hours
1	**Pharmacokinetics and Pharmacodynamics:** Nature and sources of drugs; essential drugs concept; routes of administration. Agonists, antagonists (competitive, non-competitive), spare receptors. Addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy. Pharmacokinetics: Membrane transport; absorption, distribution, metabolism, excretion (ADME). Principles and mechanisms of drug action. Receptors: Theories, classification, regulation; drug–receptor interactions and signal transduction. GPCRs, ion channel receptors, enzyme-linked receptors, JAK-STAT receptors, transcription factor–regulating receptors. Dose–response: Relationship, therapeutic index; combined drug effects; factors modifying drug action. Adverse drug reactions; drug interactions (pharmacokinetic,	18

	pharmacodynamic). Drug development: Discovery, preclinical evaluation, clinical trials (Phases I–IV), pharmacovigilance.	
2	**Chemotherapy:** General principles of chemotherapy, Chemotherapy of Infectious Diseases: Introduction, Developments, SAR, Mode of action, limitations and adverse effect of Anti-infective Agents, Beta lactam antibacterial agents (Penicillins, Cephalosporins), Tetracyclins, Macrolides, Chloramphenicol, Polyenes, Amphotrecin-B, Azoles, Amantadine, Acyclovir, Quinine, Quinolines, Quinolones, Refamycine, Sulphonamides.	**12**

References:

1. Biochemistry for the Pharmaceutical Sciences, Charles P. Woodbury, Jones & bartlett publisher, 2011
2. Text book of medical biochemistry ,S.N Chaterjea, 8 th ,Jaypee
3. Pharmaceutical biochemistry, Harbans lal, CBS Publishers and distributor, 2008
4. Introduction to Drug Design by J. R. Dimmock and S.S. Pandeya
5. The Organic Chemistry of Drug Design and Drug Action, 3rd Edition, R. B. Silverman, Academic Press, 2014
6. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed Robert F Dorge, 12th Edition, 2010

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SEMESTER – IV

Course/ Paper Title	**Practical: Modern Analytical Techniques**
Course Code	**23SMBC45MM**
Semester	IV
No. of Credits	2 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives
1. To familiarize students with fluorescence, spectrophotometric, chromatographic, electrochemical, and photometric techniques. 2. To develop practical skills in quantitative estimation of biomolecules and pharmaceutical compounds. 3. To understand the effect of experimental parameters such as pH, solvent polarity, and concentration on analytical results. 4. To train students in the application of instrumental methods for biological, pharmaceutical, and clinical samples. 5. To prepare students for research and industrial analytical laboratory work.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Perform quantitative estimation of proteins, vitamins, DNA, sugars, and drugs using instrumental techniques. 2. Apply spectrofluorometry and spectrophotometry for analysis of biological and pharmaceutical samples. 3. Use HPLC, flame photometry, polarimetry, and cyclic voltammetry for quantitative analysis. 4. Analyze experimental data and interpret results with reference to standard methods (BP/USP). 5. Demonstrate good laboratory practices, data handling, and reporting skills.

23SMBC45MM: Practical: Modern Analytical Techniques (60 Hours)

Sr. No.	**Name of the Topic**
	Perform minimum 12 Experiments from the following -
1.	Estimation of Protein by Fluorescence Method
2.	Estimation of Quinine Sulphate in Pharmaceutical Tablet by Spectrofluorometry

3.	Effect of pH or Solvent Polarity on Fluorescence of a Fluorophore.
4.	Estimation of Thiamine by Spectrofluorometry.
5.	Determination of DNA purity and concentration by Spectrophotometry.
6.	UV absorbance-based assay of plane paracetamol table using specific absorbance (British Pharmacopeia).
7.	Assay of chloramphenicol capsules by spectrophotometric method.
8.	To estimate the amount of paracetamol and diclofenac sodium in pharmaceutical tablets (USP) by HPLC technique.
9.	Determination of Na/K from biological sample by flame photometry.
10.	Quantitative estimation of sucrose by polarimetry.
11.	*In vitro* anti-inflammatory assay.
12.	Analysis of Caffeine and benzoic acid from cold drink by HPLC.
13.	Quantitative analysis of alcohol in beverages by Gas Chromatography.
14.	Quantitative estimation of quinone system or any other biological sample by Cyclic voltammetry.
15.	Interpretation of IR spectra of any two bioactive molecules.
16.	Interpretation of NMR spectra of any two bioactive molecules.
17.	Interpretation of Mass spectra of any two bioactive molecules.
18.	Interpretation of X-ray spectra of any two sample.

References:

1. Standard methods for the examination of water and wastewater, 23rd Ed. Roger B. Baird, Andrew D Eaton, Eugene W. Rice, American Public Health Association, American water works association, Water environment federation.
2. Vogels textbook of Inorganic Quantitative Analysis.
3. Ultraviolet and Visible Spectrophotometry in Pharmaceutical Analysis, Sandor Gorog, Published by CRC press, Taylor and Fransis.

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SEMESTER – IV

Course/ Paper Title	**Practical: Animal and Plant Tissue Culture**
Course Code	**23SMBC46MM**
Semester	IV
No. of Credits	2 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives
1. To introduce students to the basic and importance of Plant and Animal Tissue culture.
2. To understand the applications of these techniques in the field of research.
3. To provide knowledge of performing these techniques in laboratory for suitable research.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to –
1. Get basic knowledge of culturing plant and animal tissues.
2. Do quantitative and qualitative analysis of drugs and its applications in research and industry in cell lines.
3. Apply these techniques in various fields of life sciences and in research.

23SMBC46MM: Practical: Animal and Plant Tissue Culture (60 Hours)

Sr. No.	**Name of the Topic**
	Perform minimum 12 Experiments from the following -
1.	To learn aseptic techniques and sterilization in tissue culture.
2.	To prepare culture media and handle basic tissue culture equipment.
3.	To observe morphology of animal cell lines.
4.	To determine cell count and viability.
5.	To subculture and maintain animal cell lines.
6.	To perform cryopreservation and revival of cell lines.
7.	To evaluate cytotoxicity using MTT assay.
8.	To study cell migration by scratch assay.
9.	To assess the effect of auxins and cytokinins on plant explants.
10.	To induce callus from plant explants.
11.	To regenerate shoots and roots from callus.

12.	To isolate and culture meristematic tissues.
13.	To isolate and culture plant protoplasts.
14.	To perform anther, embryo, and endosperm culture.
15.	To micropropagate plants in vitro.
16.	To harden and acclimatize regenerated plants.

References:

1. M. K. Razdan,- Plant tissue Culture, Oxford & IBH publishing 978, 3rd Edition, 1st January 2019.
2. M.P. Singh, Sunil Kumar,- Plant tissue culture, APH Publishing, ISBN 8131304396, 9788131304396, 2009.
3. K.G.Ramawat,- Plant biotechnology, S Chand & Co 30th Jun, 2008.
4. Sudha Gangal,- Principles and practice in animal tissue culture, Universities Press, ISBN-10: 8173717192, ISBN-13: 9788173717192, 2nd Edition, 2007.
5. R. Ian Freshney,- Animal Cell Culture, Wiley Publisher, ISBN: 9781118873373, 1118873378, 6th Edition, 23 December 2015.

E- Resources: Research papers and reviews

1. https://onlinelibrary.wiley.com/doi/10.1002/9780470649367.refs
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7325846/
3. https://colostate.pressbooks.pub/clonalcryopreservation/chapter/media/
4. https://experiments.springernature.com/articles/10.1007/978-1-60327-375-6_50
5. https://www.vanderbilt.edu/viibre/CellCultureBasicsEU.pdf

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SEMESTER – IV

Course/ Paper Title	**Practical: Genomics and Proteomics**
Course Code	**23SMBC47MEA**
Semester	IV
No. of Credits	2 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives
1. Analyze gene structure, ORFs, SNPs, and regulatory elements using bioinformatics tools.
2. Characterize protein properties including structure, solubility, localization, and hydropathy.
3. Visualize and interpret protein structures using PyMOL, Discovery Studio, and PDB.
4. Integrate genomics and proteomics data for functional annotation and pathway mapping.
5. Apply protein motif/domain analysis and PPI networks for research applications.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to –
1. Identify gene features, regulatory elements, ORFs, and cSNPs using computational methods.
2. Predict and analyze protein structure, localization, solubility, and post-translational modifications.
3. Use bioinformatics tools and databases for integrative genomics-proteomics studies.
4. Map genes and proteins onto biological pathways and functional networks.
5. Conduct comparative analysis of genes and proteins across species for functional inference.

23SMBC47MEA: Practical: Genomics and Proteomics (60 Hours)

Sr. No.	**Name of the Topic**
	Perform minimum 12 Experiments from the following -
	Section A-Genomics
1.	In silico identification of exons, introns, and Open Reading Frames (ORFs) in genes.
2.	Annotation of coding SNPs (cSNPs) using genomic databases.
3.	Comparative gene analysis to identify orthologs and conserved domains.
4.	Prediction and analysis of promoter regions and transcription factor binding sites.
5.	Gene ontology (GO) analysis for functional annotation.
6.	Pathway mapping of genes using KEGG or Reactome.
7.	Analysis of gene expression data from public repositories (GEO, ArrayExpress).
8.	Integration of genomic data for prediction of gene function.

9.	Detection of microRNA target sites in genes using in silico tools.
10.	Phylogenetic analysis of selected genes across species.
	Section B-Proteomics
11.	Protein solubility and hydropathy analysis using computational tools.
12.	Prediction of protein subcellular localization using specialized software.
13.	Protein secondary and tertiary structure prediction using online tools.
14.	Protein structure visualization and analysis using PyMOL, Discovery Studio, MGLTools, and PDB.
15.	Native PAGE for protein conformation and solubility profiling.
16.	Analysis of proteins using 2D-PAGE databases for functional annotation.
17.	Integration of genomic and proteomic datasets for functional prediction.
18.	Identification of post-translational modifications using bioinformatics databases.
19.	Domain and motif analysis of proteins using Pfam, InterPro, and SMART databases.
20.	Protein-protein interaction (PPI) network analysis using STRING or Cytoscape.
21.	Comparative proteomic analysis across species for functional inference.

References:

1. Primrose, S. B., Twyman, R. M., & Primrose, S. B. (2006). Principles of Gene Manipulation and Genomics. Malden, MA: Blackwell Publishing.
2. Brown, T.A. (2016). Gene Cloning and DNA Analysis: An Introduction, 7th Edition, Wiley-Blackwell.
3. Liebler, D. C. (2002). Introduction to Proteomics: Tools for the New Biology. Totowa, NJ: Humana Press.
4. Dimitrios, V. (2015). Proteomics: From Protein Sequence to Function, 2nd Edition, Wiley.
5. Alberts, B., Johnson, A., Lewis, J., et al. (2015). Molecular Biology of the Cell, 6th Edition, Garland Science.
6. Peirce, J., et al. (2018). Bioinformatics for Biologists, 2nd Edition, CRC Press.
7. Campbell, A. M., & Heyer, L. J. (2003). Discovering Genomics, Proteomics, and Bioinformatics. San Francisco: Benjamin Cummings.
8. Lesk, A.M. (2019). Introduction to Bioinformatics, 5th Edition, Oxford University Press.

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SEMESTER – IV

Course/ Paper Title	**Practical: Human Physiology and Medical Biochemistry**
Course Code	**23SMBC47MEB**
Semester	IV
No. of Credits	2 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives
1. To be able to perform various hematological experiments in laboratory using human blood and to analyze and interpret their observations. 2. To gather knowledge on various hematological techniques like blood group identification. 3. To determination of TC, DC, ESR, Arneth count etc. of human. He /she will be able to learn various disorders related to RBC, WBC and platelets. 4. To carrying out various hematological assessments and interpreting the results.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Perform haematological tests in human subjects and interpret results. 2. Record, monitor, and document vital physiological parameters of human subjects and interpret results. 3. Discuss the significance of various physiological characteristics of the human body.

23SMBC47MEB: Practical: Human Physiology and Medical Biochemistry (60 Hours)

Sr. No.	Name of the Topic
	Perform minimum 12 Experiments from the following -
1.	Determination of blood groups (A, B, AB, O and Rh) and its significance.
2.	To determine Erythrocyte Sedimentation rate (ESR).
3.	To determine Packed Cell Volume (PCV).
4.	Blood smear and Differential white blood cell count by haemocytometer.
5.	Determination of white blood cell (WBC) count by haemocytometer.
6.	Determination of total red blood corpuscles (RBC) count by haemocytometer.
7.	Determination of Bleeding Time and Clotting Time.
8.	Estimation of hemoglobin by Sahali's method.

9.	Isolation of peripheral blood mononuclear cells (PBMCs) by density gradient method.
10.	Determination of serum Chloride by Schales & Schales method.
11.	Recording of Body Mass Index (BMI) of atleast 5 volunteers.
12.	Estimation of Bilirubin in serum / plasma using DMSO method.
13.	Estimation of Calcium in serum / plasma using Arsenazo method or O-CPC method.
14.	Estimation of Adenosine Deaminase (ADA) activity in serum / plasma.
15.	Estimation of Triglycerides in serum / plasma using GPO-POD method.
16.	Estimation of CK-MB activity in serum / plasma.
17.	Estimation of Gamma-Glutamyl Transferase (GGT) in serum / plasma.
18.	Detection of normal and abnormal constituents of urine.
19.	Test for quantitative determination of C-Reactive Protein (CRP) by using Latex Turbidimetric method.
20.	Test for detection of HCG in urine or serum samples to aid early detection of pregnancy.
21.	Interpretation of laboratory reports to optimize the drug therapy in a given clinical case. (Table work)

References:

1. Practical Human Anatomy and Physiology for Pharmacy Students, 2nd Edition by Nitin Ashok John, CBS Publishers & Distributors Pvt. Ltd. New Delhi.
2. Physiology Practical Manual by Rashmi Ramanathan, Elsevier; Special Edition, CBSPD.
3. Manual of Practical Physiology, 7th Edition by A. K. Jain, Arya Publishing Company, New Delhi.
4. A Textbook of Practical Physiology 8th Edition by C. L. Ghai, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.
5. Modern Experimental Biochemistry, 3rd Edition, by Rodney Boyer, published by Pearson Education Inc (Singapore).
6. Any other suitable reference can be included and used.

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SEMESTER – IV

Course/ Paper Title	**Genomics and Proteomics**
Course Code	**23SMBC48MEA**
Semester	IV
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. To understand genome organization and genome analysis approaches.
2. To study genome sequencing, mapping, and gene expression analysis.
3. To understand microarray technology and data interpretation.
4. To learn analytical and experimental proteomics techniques.
5. To understand applications of genomics and proteomics in biological research.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to –
1. Explain genome organization and genomic analysis methods.
2. Describe genome sequencing and mapping techniques.
3. Understand gene expression analysis using microarrays.
4. Explain proteomic techniques for protein analysis.
5. Evaluate applications of genomics and proteomics in research and drug discovery.

23SMBC48MEA: Genomics and Proteomics (30 Hours)

Sr. No.	Name of the Topic	Hours
1.	**Genome Organization and Genome Analysis:** Introduction to genes and genome organization in prokaryotes and eukaryotes; Genetic markers including RFLP, minisatellites, microsatellites, STS, EST, SSCP, RAPD, SNP, and SSR; Human genome and genomic analysis- size, features, composition, and characteristics of the human genome including sequence repeats, transposable elements, gene structure, and pseudogenes	10
2.	**Genome Sequencing, Mapping, and Gene Expression Analysis:** Genome sequencing methodologies including chain termination method, chemical degradation method, shotgun sequencing, and assembly of contiguous DNA sequences. Construction of cDNA and genomic libraries; Genomic mapping:	

	different types of genome maps and their uses, genetic and physical mapping techniques, and map resources; Practical uses of genome maps and next-generation sequencing (NGS); Gene expression and microarrays- concepts of microarrays, spotter analysis, normalization methods including total intensity, regression techniques, and ratio statistics; Clustering of gene expression profiles including hierarchical, single-linkage, complete linkage, and average linkage; Tools for microarray analysis including MADAM, SpotFinder, and SAGE; Applications of microarrays and bioinformatics challenges in microarray design and analysis	
3.	**Proteomics and Protein Analysis:** Analytical proteomics including RP-HPLC and proteome analysis by two-dimensional gel electrophoresis- general strategy, immobilized pH gradients, sample preparation, isoelectric focusing, second-dimension PAGE, staining, protein transfer, image acquisition, and analysis of 2D gels; Two-dimensional electrophoresis databases; Mass spectrometry techniques including ESI-MS and MALDI and their applications; Experimental proteomics including characterization of protein complexes, protein–protein interactions, yeast two-hybrid system, protein microarrays, and proteomics in drug discovery	

References:

1. Brown, TA., (2002). Genomes. John Wiley & Sons. Singapore.
2. Pennington, S., and Dunn, M.J.,(2001). Proteomics: From Sequence to Function. Bios Scientific Pub.Ltd. Oxford.
3. Primrose, S.B., and Twyman, R.M.,(2003). Principles of Genome Analysis. Blackwell Publishing, Oxford.
4. Simpson, R.P., (2004). Proteins and Proteomics. A Laboratory Manual. Cold Spring Harbor Laboratory Press, New York.
5. Cantor, C.R., and Smith,CL., (1999). Genomics: The Science and Technology behind the Human Genome Project, John Wiley & Sons Pvt. Ltd. Singapore.
6. Stekal, D., (2003). Microarray Bioinformatics, Cambridge University Press, Cambridge.Greg Gibson and Spencer V. Muse., A Primer of Genome Science. Sinauer Associates Inc. Publishers, Sunderlands, New York.
7. Liebler, (2001). Introduction to Proteomics, Tools for the New Biology. Humana Press, New Jersey. USA
8. Westermeier, R., and Naven, T., (2002). Proteomics in Practice. Wiley – VCH, Weinheim,Germany.

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SEMESTER – IV

Course/ Paper Title	**Drug Discovery and Development**
Course Code	**23SMBC48MEB**
Semester	IV
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. Explain the importance of pharmacokinetics, pharmacodynamics and metabolism in relation to the development of new drugs. 2. Explain the development of a given drug. 3. Describe qualitatively the structure - activity relations and discuss their significance to a specific drug development project. 4. Gain insight into Structure-Activity Relationships (SAR) and drug synthesis.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Define physicochemical properties of drugs and their biological activity. 2. Classify drug receptors and explain drug-receptor interactions, including transduction mechanisms. 3. Explain the concepts of QSAR and illustrate the parameters involved in drug design. 4. Describe the drug design process from concept to market.

23SMBC48MEB: Drug Discovery and Development (30 Hours)

Sr. No.	Name of the Topic	Hours
1	**Introduction to Drug Discovery and Development:** Ideal drug requirements; Drug classification based on therapeutic action. Generic, brand, systematic names. Pharmacon, pharmacophore, prodrug, half-life, efficacy, LD_{50}, ED_{50}, therapeutic index. Receptors, drug–receptor interaction, potency, bioavailability, toxicity, addiction. Spurious, misbranded, adulterated, generic, substandard drugs. Routes of drug administration, Types with advantages and disadvantages. Dosage forms & excipients, Stages of drug discovery and development. Lead discovery: Analog-based drug design; rational approaches (traditional medicine), random and non-random screening, serendipity.	14

	Bioisosterism: Concept, classification, bioisosteric replacement. Case studies: Any three examples.	
2	**Drug Action and Design:** Drug design approaches: Structure-based and ligand-based methods. Physicochemical properties: Acidity/basicity, solubility, ionization, hydrophobic–hydrophilic balance. Drug-likeness: Lipinski's rule, drug-likeness screening. Medicinal chemistry terminology: Pharmacology, pharmacophore, pharmacodynamics, pharmacokinetics, metabolites, antimetabolites, therapeutic index. Combinatorial chemistry: Concept and applications; solid-phase and solution-phase synthesis.	**08**
3	**Quantitative Structure Activity Relationship (QSAR):** SAR, QSAR, SAR versus QSAR, History and development of QSAR, Experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.	**08**

References:

1. Drug Discovery and Development; Technology in Transition. HP Rang. Elsevier Ltd, 2006.
2. Pharmacology in Drug Discovery. T. P. Kenakin. Elsevier, 1st Edition 2012.
3. An introduction to medicinal chemistry. G. L. Patrick. 5 th Edition Oxford UK, Oxford University Press, 2013.
4. Textbook of Drug Design. Krogsgaard-Larsen, Liljefors and Madsen (Editors), Taylor and Francis, London UK, 2002.
5. Drug Discovery Handbook S.C. Gad (Editor) Wiley-Interscience Hoboken USA, 2005.
6. Drug Discovery and Evaluation –Pharmacological assays. (1997) Ed.Vogel HG & Vogel WH Springer- New York.
7. Methods of Analysis for Functional Foods and Nutraceuticals. Chadwick R., Henson S., Mosley B., Hurst G.W.

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SEMESTER – IV

Course/ Paper Title	**Research Project**
Course Code	**23SMBC41RP**
Semester	IV
No. of Credits	6 Credits, (180 Hours)

Aims & Objectives of the Course

Objectives
To provide students with comprehensive research training in Biochemistry and related interdisciplinary areas by enabling them to identify research problems, design and perform experiments, analyze data, and communicate findings. Specifically, the project aims to: 1. Develop the ability to identify and formulate research problems with a clear Biochemistry component. 2. Train students in designing and performing biochemical and interdisciplinary experiments. 3. Enhance skills in data analysis, interpretation, and critical evaluation of literature. 4. Foster good research practices, documentation, and ethical conduct, including plagiarism-free reporting. 5. Improve the ability to communicate research findings through oral presentations, reports, and publications.

Expected Course Specific Learning Outcomes

Learning Outcome
Student should be able to – 1. Plan and execute a biochemistry-based research project, incorporating interdisciplinary approaches. 2. Apply biochemical and allied techniques for experimental work and data generation. 3. Analyze, interpret, and integrate experimental results with existing literature. 4. Maintain systematic and accurate research records while adhering to ethical practices. 5. Communicate research findings effectively through oral presentations and structured scientific reports.

23SMBC41RP: Research Project (180 Hours)

Students shall **undertake and complete a Research Project in the Fourth Semester**. This may either:

- Continue from the Third Semester project (23SMBC31RP), or
- Be a new, independent project with a clear Biochemistry component.

The project shall focus on **experimental and/or interdisciplinary research**, emphasizing **scientific investigation, critical thinking, and integration of biochemical knowledge with allied fields**.

Project Report Submission

Students shall submit **complete copies of the Project Report** to the **Department and Project Guide** at the time of examination. The report must follow the **scientific format**:

1. **Certificate** – Signed by Project Guide and Head of Department
2. **Certificates of Poster / Paper Presentation** – If applicable
3. **Self-Declaration Certificate for Plagiarism**
4. **Introduction** – Max six pages; including background, rationale, objectives, and scope
5. **Experimental Section** – Materials, methods, biochemical and interdisciplinary techniques
6. **Results and Discussion** – Data presentation, analysis, interpretation, and comparison with literature
7. **Conclusion** – Summary of findings and significance
8. **References** – Cited strictly in **ACS format**
9. **Supporting Data** – Spectroscopic, biochemical assays, graphs, images, or other relevant data
10. **Acknowledgements**

Evaluation and Examination

- The Final Project shall be evaluated jointly by all examiners.
- Students shall present their project work, results, and conclusions for 15–20 minutes, followed by a 10-minute question–answer session.
- The examination shall be of open type, emphasizing conceptual understanding, experimental methodology, data interpretation, and interdisciplinary integration.