PROGRAM OUTCOME

M.PHARM PHARMACEUTICS

PO1: Advanced Knowledge of Pharmaceutical Sciences: Students will acquire advanced knowledge of pharmaceutics, including formulation development, biopharmaceutics, pharmacokinetics, and drug delivery systems, as per the relevant monographs.

PO2: Pharmaceutical Analysis: Students will develop expertise in various analytical techniques used in drug development and manufacturing, including HPLC, GC, UV, IR, and NMR.

PO3: Advanced Drug Delivery Systems: Students will learn about the development of advanced drug delivery systems, including nanoparticles, liposomes, dendrimers, and solid lipid nanoparticles, and their applications in targeted drug delivery.

PO4: Quality Assurance and Regulatory Affairs: Students will learn about various regulatory guidelines, including the Drugs and Cosmetics Act, ICH-GCP, and CDSCO guidelines, and develop expertise in quality assurance, good manufacturing practices, and validation.

PO5: Intellectual Property Rights and Product Development: Students will be able to correlate the process of product development, with intellectual property rights, patent filing, and regulatory approvals.

PO6: Biopharmaceuticals and Pharmacokinetics: Students will develop an understanding of biopharmaceutical principles and learn about the pharmacokinetic parameters that govern drug absorption, distribution, metabolism, and excretion.

PO7: Novel Drug Delivery Approaches: Students will be able to design drug delivery systems, including transdermal, pulmonary, ocular, and intranasal delivery, and their applications in drug development.

PO8: Drug Formulation and Development: Students will develop expertise in the design, development, and optimization of drug formulations, including solid, liquid, and semi-solid dosage forms.

PO9: Research and Development: Students will participate in research projects and gain hands-on experience in advanced pharmaceutical technologies, including process development, optimization, and scale-up.

PO10: Professional and Ethical Practices: Students will develop an understanding of professional and ethical practices in the pharmaceutical industry, including safety, compliance, and good laboratory practices, and contribute to the advancement of the profession through lifelong learning and professional development.

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Course outcome for M.Pharm(Semester)

Course of study for semester I (Pharmaceutics)

Course code **Name of the subject and course outcome**

MPH101T **Modern Pharmaceutical Analytical Techniques**

Course outcome number	Course Outcomes	Cognitive level
CO1	Describe the instrumentation associated with UV-Visible spectroscopy, IR spectroscopy, spectrofluorimetric, flame emission spectroscopy, and atomic absorption spectroscopy, and choose appropriate solvents and conditions for these techniques and discuss the principles of potentiometry and ion-selective electrodes and their applications in pharmaceutical analysis.	C1
CO2	Explain the fundamental principles, laws, and theories underlying UV-Visible spectroscopy, IR spectroscopy, spectrofluorimetry, flame emission spectroscopy, and atomic absorption spectroscopy.	C2
CO3	Apply the principles and techniques of immunological assays, including Radioimmunoassay (RIA), Enzyme-Linked Immunosorbent Assay (ELISA), and Bioluminescence assays, to detect and quantify specific molecules in pharmaceutical samples.	C3
CO4	Analyze and interpret UV-Visible, IR, and fluorescence spectra to identify and characterize different compounds and understand the factors affecting their spectral features.	C4
CO5	Evaluate the advantages and disadvantages of various chromatographic techniques, such as thin-layer chromatography (TLC), high-performance liquid chromatography (HPLC), gas chromatography (GC), and electrophoresis, in pharmaceutical analysis. Provide specific examples of situations where one technique might be preferred over the others and justify your choices based on their respective principles and applications.	C5
CO6	Create NMR and IR spectrum for various compounds.	C6

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MPH102T **Drug Delivery System**

Course outcome number	Course Outcomes	Cognitive level
CO1	Understand the Principles & Fundamentals in development on novel drug delivery systems	C1
CO2	Summarize the various approaches for development of novel drug delivery systems	C2
CO3	Determining the criteria for selection of drugs and polymers for the development of delivering system	C3
CO4	Explain the formulation and evaluation of Novel drug delivery systems	C4

MPH103T **Modern Pharmaceutics**

Course outcome number	Course Outcomes	Cognitive level
CO1	To **recall** the concepts of preformulation and relate them to formulation development.	**C1**
CO2	To **illustrate** the parameters of optimization and its applications in formulation development.	**C2**
CO3	To **develop** validation and calibration master plan as per regulatory guidelines.	**C3**
CO4	To **categorize** the policies of cGMP, layout of buildings, equipment and management of production.	**C4**
CO5	To **explain** the principles of tablet compression and compaction.	**C5**
CO6	To **compile** the consolidation parameters to determine the stability of a dosage form	**C6**

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MPH104T **Regulatory Affair**

Course outcome number	Course Outcomes	Cognitive level
CO1	To recall the concepts of drug product development, innovator and generic products, their drug master file.	C1
CO2	To outline the scale up post approval changes, post marketing surveillance and outsourcing of bioavailability studies to CRO.	C2
CO3	To apply the guidelines of regulatory agencies like USFDA, EU, MHRA, TGA and ROW countries for product approval.	C3
CO4	To contrast CTD and eCTD format for combination products and medical devices.	C4
CO5	To compare the submission process of IND, NDA, ANDA and preparation of Medicinal Products Dossier.	C5
CO6	To build the ability to develop clinical trial protocol, pharmacovigilance and safety monitoring in clinical trials.	C6

MPH105P **Pharmaceutics Practical I**

Course outcome number	Course Outcomes	Cognitive level
CO1	To recall the basic principles of analytical techniques and their instrumentation used for drug analysis.	P1
CO2	To summarize the preformulation studies and basic excipients used for various controlled/sustained drug delivery systems	P2
CO3	To make use of various analytical instruments for the estimation of drugs in various formulations.	P3
CO4	To simplify the formulation techniques, prepare matrix tablets, floating tablets and cosmetics. To assess the drug release from sustained and controlled drug delivery systems.	P4
CO5	To evaluate the dosage forms, construct kinetic plots and determine similarity factors.	P5

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Course of study for semester II (Pharmaceutics)

Course code **Name of the subject and course outcome**

MPH201T **Molecular Pharmaceutics (Nano Tech and Targeted DDS)**

Course outcome number	Course Outcomes	Cognitive level
CO1	To recall basic drug targeting concepts and types of nanoparticles and liposomes, providing a foundational understanding.	C1
CO2	To illustrate tumor targeting, drug delivery principles, and gene therapy applications, going beyond basic recall to grasp deeper concepts.	C2
CO3	To develop targeting methods to design drug strategies and utilizing concepts for creating delivery systems and therapeutics.	C3
CO4	To categorize demands breaking down drug delivery advantages, limitations, and challenges, examining relationships between systems and diseases, and making informed assessments.	C4
CO5	To evaluate involves judging the effectiveness of drug systems, assessing ethical and safety aspects of gene therapy, and determining suitability for clinical applications.	C5
CO6	Creating entails designing innovative drug delivery strategies, developing novel gene delivery systems, and proposing comprehensive ethical and safe gene therapy implementation plans, demonstrating advanced problem-solving and critical thinking abilities.	C6

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MPH202T Advanced Biopharmaceutics & Pharmacokinetics

Course outcome number	Course Outcomes	Cognitive level
CO1	Remembering: Recall and define the basic concepts in biopharmaceutics and pharmacokinetics. This involves remembering key terms, definitions, and fundamental concepts related to these fields.	C1
CO2	Explain the selection of the correct pharmacokinetic model based on plasma level or urinary excretion data that best describes the process of drug absorption, distribution, metabolism, and elimination (ADME). This involves grasping the underlying principles and concepts behind different pharmacokinetic models.	C2
CO3	Determine the effect of pharmacokinetic (ADME) parameters on the biological effects of the drug by applying a one-compartment open model. This involves using knowledge and concepts to solve practical problems related to drug pharmacokinetics.	C2
CO4	Calculate various pharmacokinetic parameters from plasma and urinary excretion data by applying a multi-compartment model. This requires breaking down complex data and applying mathematical and analytical skills to derive pharmacokinetic parameters.	C3
CO5	Design dosage regimens for patients based on calculated pharmacokinetic parameters. This involves synthesizing information and creating customized drug dosage plans tailored to specific patient needs.	C4
CO6	Use plasma drug concentration-time data to calculate the pharmacokinetic parameters of a drug product by nonlinear pharmacokinetics. Additionally, calculate various pharmacokinetic parameters from plasma and urinary excretion data by applying non-compartmental pharmacokinetics. Finally, demonstrate the ability to design a basic protocol for the conduct of a bioavailability/bioequivalence (BA/BE) study and interpret the BA/BE data. This level involves critical thinking, assessment, and decision-making based on complex pharmacokinetic data and regulatory requirements.	C5

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MPH203T Computer Aided Drug Delivery System

Course outcome number	Course Outcomes	Cognitive level
CO1	Execute a comprehensive review of the history, techniques, and applications of Computer-Aided Drug Design (CADD), including the calculation of physicochemical parameters using experimental and theoretical approaches	C1
CO2	Explain prediction and analysis of ADMET (Absorption, Distribution, Metabolism, Excretion, and Toxicity) properties in drug design. Apply De novo drug design techniques, including receptor/enzyme interaction analysis, cavity size prediction, and fragment-based drug design.	C2
CO3	Analyze the process of conformational search in pharmacophore mapping. Analyze the techniques of similarity-based and pharmacophore-based virtual screening in drug design. Evaluate the potential of in-silico techniques in drug discovery.	C3
CO4	Apply the concepts of Quantitative Structure-Activity Relationships (QSAR) to derive 2D-QSAR equations. Create and analyze Hansch analysis and Free Wilson analysis. Understand the advantages and disadvantages of these methods.	C4
CO5	Evaluate the molecular modeling techniques and energy minimization methods in drug design. Evaluate molecular docking and drug-receptor interactions, including rigid docking, flexible docking, and extra-precision docking. Assess the interactions of drugs with specific enzymes.	C5
CO6	Create the concept of pharmacophore mapping, identify pharmacophore features, and create pharmacophore models. Create and analyze In Silico drug design and virtual screening protocols using similarity-based and structure-based methods.	C6

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MPH204T Cosmetic and Cosmeceuticals

Course outcome number	Course Outcomes	Cognitive level
CO1	To remember Indian regulatory requirements for manufacture, sale, import and labeling of cosmetics.	C1
CO2	To outline the biological aspects of cosmetics, basic structure, functions, common problems associated with skin, hair and oral cavity.	C2
CO3	To apply the principles of formulation building blocks for different cosmetic / cosmeceutical products.	C3
CO4	To simplify the controversial ingredients used in the formulation of cosmetics.	C4
CO5	To justify the cosmeceutical products for solving problems related to skin, hair and oral cavity.	C5
CO6	To elaborate the regulatory guidelines forherbal cosmetics, herbal ingredients used in hair care, skin care and oral care.	C6

MPH205P Pharmaceutics Practical II

Course outcome number	Course Outcomes	Cognitive level
CO1	To recall the basic techniques for the preparation of microspheres, liposomes, niosomes, and solid dispersions.	P1
CO2	To compare the dissolution studies of various marketed products.	P2
CO3	To develop various novel drug delivery systems and to evaluate the novel drug delivery systems.	P3
CO4	To test for drug binding characteristics, cell permeation and bioavailability of the formulations.	P4
CO5	To design formulations by QbD concept, use simulations for estimation of pharmacokinetics and pharmacodynamics.	P5

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Department of Pharmaceutical Chemistry

Programme Outcome (PO):

1. Graduates will have a strong foundation in the principles of organic chemistry, including the study of organic intermediates, types of reaction mechanisms, and synthetic applications.
2. Graduates will be proficient in the study of mechanism and synthetic applications of named reactions and synthetic reagents and their applications.
3. Graduates will have an in-depth understanding of the principles of medicinal chemistry, including drug discovery, prodrug design and analog design, rational design of enzyme inhibitors, and peptidomimetics.
4. Graduates will have a thorough understanding of the chemistry of natural products and their applications in drug discovery and development.
5. Graduates will be able to use modern analytical techniques such as IR, ^{1}HNMR, ^{13}CNMR, and MS spectroscopy for the structural characterization of natural compounds.
6. Graduates will be able to apply their knowledge to design and synthesize complex organic molecules and new drugs with improved efficacy and safety profiles.
7. Graduates will be able to analyse and solve complex problems in the field of organic and medicinal chemistry using critical thinking, scientific reasoning, and modern computational methods.
8. Graduates will be able to communicate scientific ideas effectively, both orally and in writing, and work collaboratively in multidisciplinary teams to achieve common goals.
9. Graduates will have the necessary skills and knowledge to pursue careers in academia, industry, or government, or to pursue advanced studies in the field of organic and medicinal chemistry.

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Course of study for semester I (Pharmaceutical Chemistry)

Course code **Name of the subject and course outcome**

MPC101T **Modern Pharmaceutical Analytical Techniques**

Course outcome number	Course Outcomes	Cognitive level
CO1	Describe the instrumentation associated with UV-Visible spectroscopy, IR spectroscopy, spectrofluorimetric, flame emission spectroscopy, and atomic absorption spectroscopy, and choose appropriate solvents and conditions for these techniques and discuss the principles of potentiometry and ion-selective electrodes and their applications in pharmaceutical analysis.	C1
CO2	Explain the fundamental principles, laws, and theories underlying UV-Visible spectroscopy, IR spectroscopy, spectroflourimetry, flame emission spectroscopy, and atomic absorption spectroscopy. Explain the thermal techniques used in pharmaceutical analysis, including differential scanning calorimetry (DSC) and differential thermal analysis (DTA), and their significance in characterizing pharmaceutical materials	C2
CO3	Apply the principles and instrumentation of various chromatographic techniques, such as thin-layer chromatography, high-performance liquid chromatography, gas chromatography, and electrophoresis, and apply these methods to separate and analyze pharmaceutical compounds.	C3
CO4	Analyze and interpret UV-Visible, IR, and fluorescence spectra to identify and characterize different compounds and understand the factors affecting their spectral features.	C4
CO5	Evaluate the advantages and disadvantages of various chromatographic techniques, such as thin-layer chromatography (TLC), high-performance liquid chromatography (HPLC), gas chromatography (GC), and electrophoresis, in pharmaceutical analysis. Provide specific examples of situations where one technique might be preferred over the others and justify your choices based on their respective principles and applications.	C5
CO6	Create NMR and IR spectrum for various compounds.	C6

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MPC1012T Advanced Organic Chemistry -I

Course outcome number	Course Outcomes	Cognitive level
CO1	**Recall** the various organic intermediates, including carbocations, carbanions, free radicals, carbenes, and nitrenes, and their methods of formation.	C1
CO2	**Explain** the stability of organic intermediates and their significance in synthetic applications.	C2
CO3	**Apply** knowledge of organic intermediates to predict their behavior in different reactions.	C3
CO4	**Analyze** different types of reaction mechanisms and the methods used to determine them.	C4
CO5	**Evaluate** the relative reactivity and orientations of reactions, including nucleophilic uni- and bimolecular reactions (SN1 and SN2), elimination reactions (E1 & E2), and rearrangement reactions.	C5
CO6	**Develop** strategies for the synthesis of complex molecules based on retrosynthetic analysis.	C6

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MPC103T Advanced Medicinal chemistry

Course outcome number	Course Outcomes	Cognitive level
CO1	Execute the stages of drug discovery, including lead identification, validation, and diversity of drug targets, and apply knowledge of biological drug targets, receptors, and theories of drug receptor interaction in drug development.	C1
CO2	Explain the source, active constituents, method of preparation, method of cultivation, collection techniques and uses of different crude drugs. Classify the crude drugs, carbohydrates, proteins, lipids and method of adulteration.	C2
CO3	Analyze medicinal chemistry concepts to systematically study and synthesize new generation molecules of various drug classes, including anti-hypertensive drugs, psychoactive drugs, anticonvulsants, and others. Create innovative molecules with enhanced properties.	C3
CO4	Apply principles of rational drug design to develop therapeutic agents. Analyze the role of stereochemistry in selective and specific therapeutic agents, considering enantioselectivity in drug adsorption, metabolism, distribution, and elimination	C4
CO5	Evaluate the principles of enzyme kinetics and enzyme inhibitors to design non-covalently and covalently binding enzyme inhibitors. Evaluate the role of enzyme inhibitors in medicine and basic research.	C5
CO6	Create medicinal chemistry concepts to systematically study and synthesize new generation molecules of various drug classes, including anti-hypertensive drugs, psychoactive drugs, anticonvulsants, and others. Create innovative molecules with enhanced properties..	C6

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MPC104T Chemistry of Natural Products

Course outcome number	Course Outcomes	Cognitive level
CO1	Recall the fundamental structures and classifications of alkaloids.	C1
CO2	Explain the diverse roles of alkaloids in pharmaceutical applications. Interpret the pharmacological relevance of flavonoid structures. Explain the biological actions of steroids based on their structures. Comprehend the biosynthesis pathways of terpenoids. Explain the molecular mechanisms underlying vitamin functions. Comprehend the role of recombinant DNA technology in identifying potential drug targets.	C2
CO3	Apply knowledge of alkaloid structures to predict their pharmacological properties. Apply understanding to correlate flavonoid structures with their medicinal properties. Apply knowledge to predict the potential activities of modified steroid structures. Apply knowledge to assess the therapeutic potential of specific terpenoid classes. Apply knowledge to elucidate the consequences of vitamin deficiencies. Apply knowledge to design strategies using recombinant DNA for drug discovery.	C3
CO4	Analyze the impact of different structural modifications on flavonoid activity. Analyze the impact of structural diversity on terpenoid bioactivity.	C4
CO5	Evaluate the relationship between steroid structures and their diverse biological effects. Evaluate the significance of vitamins in maintaining physiological balance.	C5
CO6	Develop novel approaches integrating recombinant DNA techniques for pharmaceutical innovation.	C6

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MPC105P Pharmaceutical Chemistry Practical I

Course outcome number	Course Outcomes	Cognitive level
CO1	Recall and list essential reactions of synthetic importance covered in the course. Identify key principles and theoretical concepts governing pharmaceutical chemistry practicals.	C1
CO2	Explain the mechanisms behind selected reactions in pharmaceutical chemistry. Describe the relationship between different reaction parameters and their outcomes in practical scenarios.	C2
CO3	Apply theoretical knowledge to predict and propose suitable reaction pathways for given synthetic problems. Execute laboratory techniques and methods effectively to perform reactions of synthetic importance.	C3
CO4	Analyze experimental data obtained from reactions to draw conclusions about the feasibility and success of the conducted reactions. Differentiate between various reaction types and mechanisms, identifying their advantages and limitations.	C4
CO5	Evaluate the efficacy and practical applications of reactions conducted in terms of yield, purity, and efficiency. Critically assess and compare different reaction methodologies, discussing their strengths and weaknesses.	C5
CO6	Devise novel synthesis strategies by combining learned principles and innovative approaches. Design and propose experiments that address specific pharmaceutical synthesis challenges, considering safety and environmental impact.	C6

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Course of study for semester II (Pharmaceutical Chemistry)

Course code **Name of the subject and course outcome**

MPC201T **Advanced Spectral Analysis**

Course outcome number	Course Outcomes	Cognitive level
CO1	Recall the key principles of UV and IR spectroscopy, including the factors influencing absorption spectra and the correlation between molecular structure and spectral features	C1
CO2	Demonstrate an understanding of the relationship between molecular vibrations, electronic transitions, and the resulting UV and IR spectra.	C2
CO3	Apply the principles of UV and IR spectroscopy to analyze given molecular structures, predicting and interpreting absorption bands based on provided data.	C3
CO4	Apply chromatographic techniques to separate and analyze mixtures, correlating the retention times with the chemical properties of the compounds.	C4
CO5	Analyze Raman spectra to extract molecular information, identifying characteristic vibrational modes and relating them to specific molecular structures.	C5
CO6	Evaluate the principles and applications of Radioimmunoassay in biochemical analysis, assessing its strengths and limitations in detecting specific molecules.	C6

MPC202T **Advanced Organic Chemistry -II**

Course outcome number	Course Outcomes	Cognitive level
CO1	**Recall** the principles and concepts of green chemistry, including the importance of sustainability in organic reactions.	C1
CO2	**Explain** the merits and demerits of microwave-assisted reactions, the factors affecting reaction rates in microwaves, and the effects of solvents in microwave-assisted synthesis..	C2
CO3	**Apply** knowledge of microwave technology to optimize organic reactions and synthesize heterocycles using microwave-assisted techniques.	C3
CO4	**Analyze** the principles and mechanisms of coupling reactions in peptide synthesis.	C4
CO5	**Evaluate** the principles of solid-phase peptide synthesis, comparing t-BOC and FMOC protocols, and assess various solid supports and linkers.	C5
CO6	**Develop** strategies for the synthesis of peptides, including activation procedures, peptide bond formation, deprotection, cleavage from resin, and purification, with the ability to apply these concepts to case studies.	C6

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MPC203T Computer Aided Drug Design

Course outcome number	Course Outcomes	Cognitive level
CO1	Execute a comprehensive review of the history, techniques, and applications of Computer-Aided Drug Design (CADD), including the calculation of physicochemical parameters using experimental and theoretical approaches	C1
CO2	Explain prediction and analysis of ADMET (Absorption, Distribution, Metabolism, Excretion, and Toxicity) properties in drug design. Apply De novo drug design techniques, including receptor/enzyme interaction analysis, cavity size prediction, and fragment-based drug design.	C2
CO3	Analyze the process of conformational search in pharmacophore mapping. Analyze the techniques of similarity-based and pharmacophore-based virtual screening in drug design. Evaluate the potential of in-silico techniques in drug discovery.	C3
CO4	Apply the concepts of Quantitative Structure-Activity Relationships (QSAR) to derive 2D-QSAR equations. Create and analyze Hansch analysis and Free Wilson analysis. Understand the advantages and disadvantages of these methods.	C4
CO5	Evaluate the molecular modeling techniques and energy minimization methods in drug design. Evaluate molecular docking and drug-receptor interactions, including rigid docking, flexible docking, and extra-precision docking. Assess the interactions of drugs with specific enzymes.	C5
CO6	Create the concept of pharmacophore mapping, identify pharmacophore features, and create pharmacophore models. Create and analyze In Silico drug design and virtual screening protocols using similarity-based and structure-based methods.	C6

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MPC204T Pharmaceutical Process Chemistry

Course outcome number	Course Outcomes	Cognitive level
CO1	Students will recall and comprehend the foundational principles and theories of extraction, filtration, distillation, evaporation, crystallization, and their applications in pharmaceutical process chemistry.	C1
CO2	Students will devise innovative strategies to improve and optimize pharmaceutical process chemistry techniques, showcasing an understanding of advanced concepts and their practical applications in the field.	C2
CO3	Students will apply their understanding of unit processes like nitration, halogenation, oxidation, reduction, fermentation, and reaction progress kinetic analysis to create optimized pharmaceutical process protocols.	C3
CO4	By applying knowledge of unit operations, students will analyze and differentiate between various techniques such as extraction methods, filtration processes, distillation setups, evaporation conditions, and crystallization parameters in pharmaceutical production.	C4
CO5	Students will critically analyze and evaluate the safety protocols involved in industrial practices within pharmaceutical process chemistry, emphasizing hazard identification, risk assessment, and mitigation strategies.	C5
CO6	By integrating course content, students will design comprehensive safety measures and protocols for various chemical processes involved in pharmaceutical manufacturing, demonstrating a capacity to create robust safety frameworks while evaluating their effectiveness.	C6

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MPC205P Pharmaceutical Chemistry Practical II

Course outcome number	Course Outcomes	Cognitive level
CO1	Recall and list fundamental reactions and mechanisms involved in various synthetic processes of pharmaceutical compounds discussed in the course. Memorize and differentiate the key properties and characteristics of different classes of pharmaceutical compounds.	C1
CO2	Explain the principles behind the synthesis of complex pharmaceutical compounds, elucidating the relationship between molecular structures and biological activity. Interpret and illustrate the chemical transformations in pharmaceutical synthesis pathways.	C2
CO3	Apply theoretical knowledge to propose and design synthetic routes for the preparation of specific pharmaceutical compounds. Execute advanced laboratory techniques proficiently to carry out synthesis and isolation of pharmaceutical intermediates.	C3
CO4	Analyze experimental data obtained from reactions to deduce mechanisms and pathways followed in the synthesis of pharmaceutical compounds. Differentiate between reaction outcomes, determining the effects of varying reaction conditions on product yields and purity.	C4
CO5	Evaluate the efficiency and reliability of synthetic routes employed in pharmaceutical synthesis based on yield, purity, and scalability. Critically assess the feasibility and practicality of proposed synthetic strategies in terms of cost, safety, and environmental impact.	C5
CO6	Devise novel synthetic methodologies integrating multiple reaction types to create innovative pharmaceutical compounds. Design and propose experiments to address specific challenges in pharmaceutical synthesis, integrating safety and ethical considerations.	C6

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PROGRAM OUTCOMES-M.PHARM (PHARMACEUTICAL ANALYSIS)

PO1. Pharmaceutical Sciences knowledge: Apply the knowledge of mathematics, science, pharmaceutical fundamentals, and a Pharmacy specialization to the solution of complex Pharmaceutical problems.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO3. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO4. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO5. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO6. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO7. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO8. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PO9: Conduct investigations of complex problems: To understand biopharmaceutical principles and pharmacokinetic principles through different compartment models, multiple dosage regimens, non-linear pharmacokinetics, and assessment of bioavailability and bioequivalence

PO10. Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

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Course of study for semester I (Pharmaceutical Analysis)

Course code **Name of the subject and course outcome**

MPA101T **Modern Pharmaceutical Analytical Techniques**

Course outcome number	Course Outcomes	Cognitive level
CO1	Describe the instrumentation associated with UV-Visible spectroscopy, IR spectroscopy, spectrofluorimetric, flame emission spectroscopy, and atomic absorption spectroscopy, and choose appropriate solvents and conditions for these techniques and discuss the principles of potentiometry and ion-selective electrodes and their applications in pharmaceutical analysis.	C1
CO2	Explain the fundamental principles, laws, and theories underlying UV-Visible spectroscopy, IR spectroscopy, spectroflourimetry, flame emission spectroscopy, and atomic absorption spectroscopy. Explain the thermal techniques used in pharmaceutical analysis, including differential scanning calorimetry (DSC) and differential thermal analysis (DTA), and their significance in characterizing pharmaceutical materials	C2
CO3	Apply the principles and instrumentation of various chromatographic techniques, such as thin-layer chromatography, high-performance liquid chromatography, gas chromatography, and electrophoresis, and apply these methods to separate and analyze pharmaceutical compounds.	C3
CO4	Analyze and interpret UV-Visible, IR, and fluorescence spectra to identify and characterize different compounds and understand the factors affecting their spectral features.	C4
CO5	Evaluate the advantages and disadvantages of various chromatographic techniques, such as thin-layer chromatography (TLC), high-performance liquid chromatography (HPLC), gas chromatography (GC), and electrophoresis, in pharmaceutical analysis. Provide specific examples of situations where one technique might be preferred over the others and justify your choices based on their respective principles and applications.	C5
CO6	Create NMR and IR spectrum for various compounds.	C6

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MPA102T Advanced Pharmaceutical Analysis

Course outcome number	Course Outcomes	Cognitive level
CO1	Define and differentiate various types of impurities found in drug substances, including elemental impurities, residual solvents, and degradation products, in accordance with ICH guidelines.	C1
CO2	Explain the regulatory requirements and protocols for stability testing of phytopharmaceuticals, utilizing techniques such as HPTLC/HPLC fingerprinting to assess interactions and complexity.	C2
CO3	Prepare the ability to develop analytical methods and conduct stability studies, following WHO and ICH stability testing guidelines, to determine shelf life and assess impurity profiling and degradant characterization.	C3
CO4	Analyze and quantify impurities in active pharmaceutical ingredients (APIs) and drug products, demonstrating a comprehensive understanding of impurity classification and reporting	C4
CO5	Evaluate and apply stability testing protocols, including batch selection, storage conditions, and test parameters, while considering the influence of factors like temperature, pH, and ionic strength on degradation rates.	C5
CO6	Perform biological tests and assays on various food items, such as vaccines, hormones, and antivenom.	C6

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MPA103T **Pharmaceutical Validation**

Course outcome number	Course Outcomes	Cognitive level
CO1	Understand the complexities of computerized system validation, particularly in the context of electronic records and digital significance, as regulated by 21 CFR Part 11 and GAMP 5.	C1
CO2	Explain the principles of analytical method validation, adhering to guidelines provided by ICH and USP, to ensure the accuracy, reliability, and suitability of methods used in pharmaceutical analysis and the concepts of qualification and validation, emphasizing their advantages and the importance of streamlining the qualification and validation process in the pharmaceutical industry.	C2
CO3	Demonstrate a deep understanding of pharmaceutical equipment qualification, including the development of User Requirement Specifications, Design Qualification, Factory/Site Acceptance Tests, Installation Qualification, Operational Qualification, and Performance Qualification.	C3
CO4	Qualify analytical instruments and glassware commonly used in pharmaceutical analysis, such as electronic balances, pH meters, spectrophotometers, chromatographs, and various glassware items, ensuring their precision and accuracy.	C4
CO5	Validate utility systems crucial to pharmaceutical manufacturing, such as pharmaceutical water systems, HVAC systems, compressed air, and nitrogen, as well as implement cleaning validation procedures for equipment and facilities.	C5
CO6	Create analytical methods for evaluating pharmaceutical processes and products through the design and execution of experiments in pharmaceutical validation.	C6

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MPA104T Food Analysis

Course outcome number	Course Outcomes	Cognitive level
CO1	**Recall** and recognize the key principles and characteristics of various food components, such as carbohydrates, proteins, lipids, vitamins, food additives, and pigments. They should also remember the methods of analysis associated with each of these components.	C1
CO2	**Understanding** of the underlying chemistry and properties of food components. They will comprehend the classification and characteristics of carbohydrates, proteins, lipids, vitamins, and food additives. They will also understand the principles of microbial assays for vitamins and the detection methods for pigments and synthetic dyes.	C2
CO3	**Apply** their knowledge to real-world scenarios. They should apply general methods of analysis to determine the composition and quality of food components. They will apply their understanding of refining fats and oils, detecting spoilage, and analyzing fermentation products.	C3
CO4	**Analyze** food samples and identify the presence of adulterants, contaminants, and pesticide residues. They will analyze the effects of pesticides on various food products and evaluate the compliance of food products with legislation and regulations.	C4
CO5	**Evaluate** the safety and quality of food products based on their analytical results. They will assess the impact of processing on food components and make judgments regarding the suitability of food additives in various products.	C5
CO6	**Create** a design and conduct experiments related to food analysis. They will create analytical methods for specific food components and products, developing a deeper understanding of food chemistry and analysis in the context of food safety and quality.	C6

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MPA105P Pharmaceutical Analysis Practical I

Course outcome number	Course Outcomes	Psychomotor Level
CO1	Perform the analysis of pharmacopoeial compounds and their formulations using UV-Vis spectrophotometers by closely imitating proper operational procedures and conducting spectral analysis with precision.	P1
CO2	The ability to execute simultaneous estimations of multi-component containing formulations by UV spectrophotometry with a high degree of precision and accuracy. They will demonstrate adept manipulation of complex analytical techniques.	P2
CO3	Develop advanced skills in conducting experiments based on High-Performance Liquid Chromatography (HPLC) with meticulous precision, including sample preparation, column packing, mobile phase selection, and chromatographic separation, ensuring reliable and accurate results.	P3
CO4	Apply the articulate skills in performing experiments based on Gas Chromatography, including sample injection, column selection, and chromatogram interpretation, demonstrating competence in gas chromatographic techniques.	P4
CO5	Design a natural and competent understanding and application of specialized techniques such as fluorimetry for estimating riboflavin/quinine sulfate, flame photometry for estimating sodium/potassium, various titration methods, instrumental assays, calibration procedures for different instruments, cleaning validation, and a wide range of food analysis techniques. They will be able to naturally and proficiently apply these techniques in practical settings.	P5

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Course of study for semester II (Pharmaceutical Analysis)

Course code **Name of the subject and course outcome**

MPA201T **Advanced Instrumental Analysis**

Course outcome number	Course Outcomes	Cognitive level
CO1	Discuss the principles of NMR spectroscopy, including quantum numbers, solvent requirements, relaxation processes, chemical shifts, spin-spin coupling, and nuclear magnetic double resonance, and their interpretation and applications and the principles of NMR spectroscopy, including quantum numbers, solvent requirements, relaxation processes, chemical shifts, spin-spin coupling, and nuclear magnetic double resonance, and their interpretation and applications.	C1
CO2	Explain the principles, theory, and instrumentation of mass spectrometry, including various ionization techniques, mass fragmentation, and isotopic peak analysis and the principles and instrumentation of gas chromatography, including derivatization, headspace sampling, columns, detectors, and quantification.	C2
CO3	Apply the principles and instrumentation of high-performance thin-layer chromatography (HPTLC) and its pharmaceutical applications.	C3
CO4	Analyze pharmaceutical applications and principles of size exclusion chromatography, ion exchange chromatography, ion pair chromatography, and affinity chromatography in bio chromatography.	C4
CO5	Outline the principles and pharmaceutical applications of supercritical fluid chromatography and capillary electrophoresis.	C5
CO6	Design and conduct experiments in the field of pharmaceuticals using advanced instrumental analysis to develop analytical methods.	C6

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MPA202T Modern Bio-Analytical Techniques

Course outcome number	Course Outcomes	Cognitive level
CO1	Discuss the application of LC-MS in bioactivity screening and proteomics and the basic equipment and procedures used in cell culture techniques, including cell isolation, subculture, cryopreservation, and characterization, and explain the principles and applications of cell viability assays (MTT assays) and flow cytometry.	C1
CO2	Explain the process of bioanalytical method validation in accordance with the guidelines provided by USFDA and EMEA.	C2
CO3	Apply the principles and procedures involved in the extraction of drugs and metabolites from biological matrices using various bioanalytical methods, including protein precipitation, liquid-liquid extraction, solid-phase extraction, and novel sample preparation approaches.	C3
CO4	Analyze biopharmaceutical factors that influence drug bioavailability, including dissolution and drug release testing, and discuss alternative methods of dissolution testing and transport models and analyze in-vitro assays of drug metabolites and drug-metabolizing enzymes.	C4
CO5	Examine metabolite identification using in-vitro and in-vivo approaches, including protocols and sample preparation, and evaluate the role of microsomal approaches (Rat liver microsomes and Human liver microsomes) in metabolite identification and examine the solubility of drugs using experimental methods and evaluate drug permeability through in-vitro, in-situ, and in-vivo approaches.	C5
CO6	Create illustrative materials, including charts, diagrams, and key features, to visually represent the concepts and processes involved in the following topics use of microsomal approaches, such as Rat Liver Microsomes (RLM) and Human Liver Microsomes (HLM), in metabolite identification and protein precipitation, liquid-liquid extraction, solid-phase extraction, and innovative sample preparation techniques.	C6

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MPA203T **Quality Control and Quality Assurance**

Course outcome number	Course Outcomes	Cognitive level
CO1	Describe the documentation requirements in the pharmaceutical industry, including the three-tier documentation system, standard operating procedures, quality audit plans, and electronic data management. .	C1
CO2	Explain the concept and evolution of Quality Control and Quality Assurance in the pharmaceutical industry, including Good Laboratory Practices (GLP) and Good Manufacturing Practices and demonstrate the ability to perform the analysis of raw materials, finished products, and packaging materials in pharmaceutical manufacturing, and develop specifications following ICH Q6 and Q3 guidelines.	C2
CO3	Apply the knowledge acquired in the course to real-world pharmaceutical quality control and assurance scenarios, demonstrating the ability to make informed decisions and ensure compliance with industry standards and regulations.	C3
CO4	Analyze the key guidelines and regulations related to quality control and assurance, including ICH guidelines, GMP according to various standards, and CPCSEA guidelines.	C4
CO5	Evaluate the various aspects of quality control and assurance in pharmaceutical manufacturing, including quality audit reports, deviation handling, and change control procedures and examine manufacturing operations and controls in pharmaceutical production, covering topics such as sanitation, processing, packaging, quality control, and aseptic processes, ensuring compliance with relevant regulations.	C5
CO6	Create a visual representation, including charts, diagrams, and key features, illustrating concepts and processes related to Quality Control and Quality Assurance in the pharmaceutical industry, cGMP guidelines, analysis of pharmaceutical materials, documentation practices, and manufacturing operations and controls.	C6

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MPA204T **Herbal and Cosmetic Analysis**

Course outcome number	Course Outcomes	Cognitive level
CO1	**Recall** key concepts related to herbal remedies and cosmetics, including regulations governing herbal medicines, the standards for herbal drug standardization, and the Indian and international patent laws related to herbal drugs and natural products.	C1
CO2	**Understanding** of the principles underlying herbal and cosmetic analysis. They will comprehend the concepts of herbal drug adulteration, DNA fingerprinting techniques for identification, regulatory requirements for the herbal drug industry, and the quality assessment of herbal drugs through various pharmacopoeias.	C2
CO3	**Apply** their knowledge to practical scenarios. They will apply the principles of herbal drug standardization and testing, including the evaluation of herbal drug-drug interactions and the assessment of safety in herbal medicine.	C3
CO4	**Analyze** herbal remedies and cosmetic products. They will analyze the factors contributing to herbal drug adulteration, assess the quality of raw materials used in cosmetics, and understand the challenges in monitoring the safety of herbal medicines.	C4
CO5	**Evaluate** the efficacy and safety of herbal remedies and cosmetic products. They will assess the regulatory requirements and standards for herbal drugs and cosmetics and make informed judgments about their quality and compliance.	C5
CO6	**Create** a design and conduct experiments related to herbal and cosmetic analysis. They will create analytical methods for assessing the quality of herbal drugs and cosmetic raw materials, contributing to the development of safer and more effective herbal and cosmetic products.	C6

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MPA205P Pharmaceutical Analysis Practical II

CO1	Effectively compare absorption spectra using UV and apply the Woodward-Fieser rule to interpret and identify organic compounds. They will imitate established procedures for spectral analysis and rule application.	P1
CO2	The ability to manipulate and interpret organic compounds effectively using FT-IR (Fourier Transform Infrared Spectroscopy). They will demonstrate adept manipulation of the instrument and interpret spectra with precision.	P2
CO3	Develop advanced skills in interpreting organic compounds using NMR (Nuclear Magnetic Resonance) spectroscopy. They will pay meticulous attention to detail and accurately interpret NMR spectra.	P3
CO4	Articulate their understanding of organic compounds through Mass Spectrometry (MS) interpretation. They will demonstrate competence in identifying compounds using mass spectra	P4
CO5	Understanding of a wide range of analytical techniques, including DSC (Differential Scanning Calorimetry) for purity determination, FT-IR, NMR, CNMR, and Mass Spectrometry for compound identification. They will also be proficient in conducting bioanalytical method validation, analyzing pharmaceutical products (tablets, capsules, parenteral, creams), and performing quality control tests on raw materials, packing materials, and drugs. Additionally, they will be able to apply various techniques for the analysis of cosmetics and hair care products, demonstrating naturalization of these complex analytical methodologies.	P5

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PROGRAM OUTCOME FOR M.PHARMACY (PHARMACOLOGY)

PO1 Postgraduates will acquire adequate scientific information regarding basic principles of Pharmaceutical and Medicinal chemistry, Pharmaceutics including Cosmetology, Pharmacology and Pharmacognosy. They will also have hands on training of practical aspects of Synthesis of APIs and its intermediates along with Formulation and Development, Analysis and Quality assurance of various pharmaceutical dosage forms including those of herbal origin as per standards of official books, WHO, and other regulatory agencies.

PO2 Postgraduates will develop an ability to plan, visualize and work on multidisciplinary tasks. They will be able to demonstrate necessary skills (eg. working independently, time management and organizational skills).They will demonstrate an adaptable, flexible and effective approach towards organizational development.

PO3 Postgraduates will be able to think logically and solve the problems, will develop an ability to conduct, analyze and interpret data of pharmaceutical experiments in various departments (Eg: Drug discovery, Formulation & Development, Production, Quality control & Quality assurance etc) as per the needs of pharmaceutical industries.

PO4 Postgraduates will master the key concepts in the discipline of their interest in pharmaceutical sciences. They will demonstrate these skills to use modern pharmaceutical tools, software, and equipments to analyze & solve problems.

PO5 Postgraduates will develop leadership and interpersonal skills such as influencing others, negotiating and working with others, conflict management and leading others through the problem-solving process. They will be able to lead and function both individually and as a member of a team.

PO6 Postgraduates will apply theoretical and practical skills developed through classroom, laboratories and team project experiences and thus will develop confidence and will be able to i) do specialized research in the core and applied areas of pharmaceutical sciences. ii) manufacture, analyse and assure the drug based formulations. iii) promote and market the pharmaceuticals and iv) train the budding pharmacist to become self- reliant pharmacist and a health care professional.

PO7 Postgraduates will demonstrate knowledge of professional and ethical responsibilities as per pharmaceutical jurisprudence. The graduates will swear by a code of ethics of Pharmacy Council of India in relation to community and shall act as integral part of a health care system. They will demonstrate honesty, integrity, ethical understanding, and respect for others and will carry out their professional responsibilities by adhering to high ethical standards.

PO8 Postgraduates will acquire excellent interpersonal oral communication and writing skills.

Course of study for semester I (Pharmacology)

Course code **Name of the subject and course outcome**

MPL 101T **Modern Pharmaceutical Analytical Techniques**

Course outcome number	Course Outcomes	Cognitive level
CO1	Describe the instrumentation associated with UV-Visible spectroscopy, IR spectroscopy, spectrofluorimetric, flame emission spectroscopy, and atomic absorption spectroscopy, and choose appropriate solvents and conditions for these techniques and discuss the principles of potentiometry and ion-selective electrodes and their applications in pharmaceutical analysis.	C1
CO2	Explain the fundamental principles, laws, and theories underlying UV-Visible spectroscopy, IR spectroscopy, spectroflourimetry, flame emission spectroscopy, and atomic absorption spectroscopy. Explain the thermal techniques used in pharmaceutical analysis, including differential scanning calorimetry (DSC) and differential thermal analysis (DTA), and their significance in characterizing pharmaceutical materials	C2
CO3	Apply the principles and instrumentation of various chromatographic techniques, such as thin-layer chromatography, high-performance liquid chromatography, gas chromatography, and electrophoresis, and apply these methods to separate and analyze pharmaceutical compounds.	C3
CO4	Analyze and interpret UV-Visible, IR, and fluorescence spectra to identify and characterize different compounds and understand the factors affecting their spectral features.	C4
CO5	Evaluate the advantages and disadvantages of various chromatographic techniques, such as thin-layer chromatography (TLC), high-performance liquid chromatography (HPLC), gas chromatography (GC), and electrophoresis, in pharmaceutical analysis. Provide specific examples of situations where one technique might be preferred over the others and justify your choices based on their respective principles and applications.	C5
CO6	Create NMR and IR spectrum for various compounds.	C6

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MPL 102T Advanced Pharmacology-I

Course outcome number	Course Outcomes	Cognitive level
CO1	Recall and list the key components and classifications of systemic pharmacology, including drug mechanisms and interactions	C1
CO2	Demonstrate a comprehensive understanding of autonomic pharmacology, explaining the functions and impact of drugs on the central nervous system and the autonomic nervous system.	C2
CO3	Apply knowledge of central nervous system pharmacology to analyze and propose pharmacotherapeutic interventions for neurological disorders, considering drug actions and potential side effects.	C3
CO4	Analyze cardiovascular pharmacology, evaluating the effects of drugs on the cardiovascular system and assessing their implications for the treatment of various cardiovascular conditions.	C4
CO5	Evaluate the significance of autocoid pharmacology, assessing the role of autocoids in physiological processes and their potential therapeutic applications	C5
CO6	Develop innovative approaches to address complex clinical scenarios in advanced pharmacology, integrating knowledge from systemic, autonomic, central nervous system, cardiovascular, and autocoid pharmacology to optimize patient care. .	C6

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MPL 103T **Pharmacological and Toxicological Screening Methods-I**

Course outcome number	Course Outcomes	Cognitive level
CO1	Recall and list the fundamental principles and methodologies of pharmacological screening using in vivo and in vitro techniques	C1
CO2	Demonstrate a comprehensive understanding of the preclinical screening methods for pharmacological and toxicological activities, including the principles of immunoassay and general principles of animal alternative models	C2
CO3	Apply knowledge of pharmacological and toxicological screening methods to design and implement experiments, considering the ethical use of laboratory animals and alternative models..	C3
CO4	Analyze the preclinical screening data obtained from in vivo and in vitro experiments, critically evaluating the pharmacological and toxicological effects of substances on laboratory animals..	C4
CO5	Evaluate the significance of immunoassay principles and their application in pharmacological and toxicological screening, assessing the reliability and validity of obtained results.	C5
CO6	Develop innovative approaches to improve preclinical screening methods, considering advancements in in vitro techniques and alternative models, and proposing ethical considerations for laboratory animal use in research..	C6

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MPL 104T **Cellular and Molecular Pharmacology**

Course outcome number	Course Outcomes	Cognitive level
CO1	Recall and list the fundamental principles of cellular and molecular pharmacology, including cell signaling pathways, cell culture techniques, and genomic and proteomic tools.	C1
CO2	Demonstrate a comprehensive understanding of cellular and molecular pharmacology, explaining the principles of genomic and proteomic tools, recombinant DNA technology, gene therapy, and pharmacogenomics.	C2
CO3	Apply knowledge of cellular and molecular pharmacology to design and perform experiments using cell culture techniques, recombinant DNA technology, and genomic tools.	C3
CO4	Analyze the principles and applications of genomic and proteomic tools, critically evaluating the data obtained from experiments in cellular and molecular pharmacology	C4
CO5	Evaluate the potential of immunotherapeutics in pharmacological interventions, considering their application in different diseases and understanding the principles of pharmacogenomics.	C5
CO6	Develop innovative approaches to utilize cellular and molecular pharmacology techniques for therapeutic interventions, proposing novel strategies for drug development and treatment based on genomic and proteomic knowledge.	C6

MPL 105P **Pharmacology Practical I**

Course outcome number	Course Outcomes	Psycomotor level
CO1	Demonstrate the accurate imitation of laboratory techniques involved in in-vitro drug testing.	P1
CO2	Execute drug formulation processes with precision and accuracy.	P2
CO3	Apply precision in dosage calculations and drug administration techniques	P3
CO4	Communicate effectively about pharmacological concepts and experimental findings.	P4
CO5	Integrate pharmacological knowledge into real-world scenarios, demonstrating an understanding of drug interactions and implications	P5

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Course of study for semester II (Pharmacology)

Course code **Name of the subject and course outcome**

MPL 201T **Advanced Pharmacology II**

Course outcome number	Course Outcomes	Cognitive level
CO1	Reproduce and list the major drug classifications and concepts discussed in the course, including those related to endocrine pharmacology, antimicrobial agents, chemotherapy, immunopharmacology, GIT pharmacology, and free radicals pharmacology.	C1
CO2	Describe molecular and cellular mechanisms of hormone actions, as well as the mechanisms of drug actions and resistance for various drug classes, including anti-thyroid drugs, oral hypoglycemic agents, and antibiotics.	C2
CO3	Dramatize their understanding of pharmacology to design treatment plans for specific diseases, such as diabetes, infections, cancer, and gastrointestinal disorders, considering drug selection, dosing, and patient-specific factors.	C3
CO4	Differentiate the role of pharmacological agents in the etiology and treatment of diseases, including their effects on free radicals, immune responses, and biological rhythms, and evaluate the efficacy of therapeutic approaches.	C4
CO5	Contrast the safety and effectiveness of drug therapies in various disease contexts, including assessing adverse effects, patient compliance, and therapeutic outcomes, and make recommendations based on their assessments.	C5
CO6	Develop knowledge by developing innovative treatment strategies for recent advances in diseases like Alzheimer's, Parkinson's, cancer, and diabetes, incorporating the latest research findings and pharmacological concepts.	C6

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MPL 202T **Pharmacological and Toxicological Screening Methods-II**

Course outcome number	Course Outcomes	Cognitive level
CO1	Outline and define key concepts in toxicology, such as acute and chronic studies, reproductive toxicology, genotoxicity, carcinogenicity, safety pharmacology, and regulatory guidelines like OECD, ICH, EPA, and Schedule Y.	C1
CO2	Discuss the significance of GLP in conducting toxicity studies and comprehend the principles and importance of safety pharmacology, including tiered assessments of cardiovascular, central nervous system, and respiratory safety.	C2
CO3	Compute their knowledge to design and conduct various types of toxicity studies, such as acute, sub-acute, chronic, dermal, inhalational, reproductive, genotoxicity, and carcinogenicity studies and apply test item characterization methods to regulatory toxicology studies.	C3
CO4	Distinguish the principles and applications of toxicokinetics in preclinical studies, considering factors like saturation kinetics and evaluating the importance and potential of alternative methods to animal toxicity testing.	C4
CO5	Assess the importance of IND enabling studies in drug development, including the industry perspective, and assess the list of studies needed for IND submission, considering their role in ensuring drug safety.	C5
CO6	Develop to synthesize knowledge by creating comprehensive safety assessment plans for drug development, considering toxicological study design, safety pharmacology, and alternative testing methods, while complying with regulatory guidelines.	C6

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MPL 203T Principles of Drug Discovery

Course outcome number	Course Outcomes	Cognitive level
CO1	Remember and list the essential stages in drug discovery, including target identification, lead optimization, and the use of genomics, proteomics, and bioinformatics.	C1
CO2	Explain how genomics, proteomics, bioinformatics, nucleic acid microarrays, protein microarrays, antisense technologies, siRNAs, antisense oligonucleotides, and transgenic animals are used in target discovery and validation.	C2
CO3	Execute their understanding of combinatorial chemistry, high throughput screening, *in-silico* lead discovery techniques, assay development, and protein structure prediction to the lead identification process.	C3
CO4	Categorize the differences between traditional and rational drug design, explore methods like structure and pharmacophore-based approaches, and assess the various techniques used in virtual screening and docking.	C4
CO5	Evaluate the historical development of QSAR, compare SAR and QSAR, and assess the relevance and practical applications of QSAR statistical methods and 3D-QSAR approaches.	C5
CO6	Develop knowledge by creating prodrug designs that address issues like drug solubility, absorption, distribution, site-specific drug delivery, and sustained drug action, considering the rationale and practical considerations of prodrug design.	C6

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MPL 204T clinical research and pharmacovigilance

Course outcome number	Course Outcomes	Cognitive level
CO1	List key principles of international regulatory guidelines such as ICH-GCP, ethical considerations outlined by Institutional Review Boards, and ethical guidelines for biomedical research as per Schedule Y and ICMR.	C1
CO2	Discuss the different types and designs of clinical trials, including experimental studies like RCTs and non-RCTs, as well as observational studies like cohort, case-control, and cross-sectional studies.	C2
CO3	Implement their understanding of the roles and responsibilities of clinical trial personnel, including investigators, study coordinators, sponsors, and contract research organizations. They will also apply guidelines for preparing clinical trial documents.	C3
CO4	Categorize safety monitoring in clinical trials, including the definition, types, detection, reporting, severity, seriousness, predictability, preventability, and management of adverse drug reactions (ADRs).	C4
CO5	Justify the historical progress of pharmacovigilance, its significance in medication safety, and its international and national aspects. They will assess roles and responsibilities in pharmacovigilance and methods/tools used, including spontaneous reporting systems and statistical methods.	C5
CO6	Develop knowledge by creating pharmacovigilance strategies, developing safety evaluation methods, and understanding pharmacoeconomics, safety pharmacology, and pharmacoepidemiology concepts.	C6

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MPL 205P **Pharmacology Practical II**

Course outcome number	Course Outcomes	Cognitive level
CO1	Imitate and demonstrate basic laboratory skills required for recording DRCs of agonists using suitable isolated tissue preparations.	P1
CO2	Manipulate experimental conditions and study the effects of antagonist and potentiating agents on DRCs of agonists using suitable isolated tissue preparations.	P2
CO3	Achieve a high level of precision in executing bioassay techniques, including matching, interpolation, bracketing, and multiple point assays, to determine the strength of unknown samples using suitable tissue preparations.	P3
CO4	Articulate mastery of various pharmacological experiments and assessments, including drug absorption studies, acute oral and dermal toxicity studies, repeated dose toxicity studies, and drug mutagenicity studies using mice bone-marrow chromosomal aberration test.	P4
CO5	Reach a level of naturalization where practical skills become automatic and integrated into the design and execution of pharmacological experiments, clinical trial protocol design, ADR monitoring protocol design, *in-silico* docking studies, pharmacophore-based screening, QSAR studies, and ADR reporting.	P5

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M.PHARM (Pharmacy Practice)- Program Outcome

PO1: Foundational Life Sciences Knowledge: Students will acquire fundamental knowledge of physiology, anatomy, formulation science, and applied biochemistry, as well as the chemistry of organic and inorganic compounds, as per the relevant monographs.

PO2: Pathology and Pharmacology Knowledge: Students will develop a thorough understanding of relevant aspects of pathophysiological mechanisms, the application of microbiology in pharmacy, medical uses of natural drugs, and pharmacological aspects of drugs.

PO3: Community Pharmacy Knowledge: Students will acquire skills such as dispensing drugs, ensuring safe medication usage, patient counselling, and improving patient care in community pharmacy settings.

PO4: Clinical Pharmacist Knowledge: Students will enhance their practical clinical skills through discussions, attending ward rounds, monitoring patients' progress, and presenting cases at discharge. They will also participate in awareness programs and health check-up camps to cultivate their social responsibility as clinical pharmacists.

PO5: Environmental and Sustainability Knowledge: Students will learn about instrumental techniques applied in Good Laboratory Practice and following ICH-GCP guidelines, total quality management, quality review and documentation, and study regulatory bodies such as the Drugs and Cosmetics Act, CDSCO guidelines, pertaining to the regulatory environment.

PO6: Design, Development, and Investigation of Complex Problems: Students will study the modern concept of rational drug design, such as Quantitative Structure Activity Relationship, Computer Aided Drug Design, and the concept of antisense molecules. They will also understand biopharmaceutical and pharmacokinetic principles.

PO7: Toxicology Knowledge: Students will learn about the toxicological aspects of individual classes of xenobiotics such as pesticides, opiates, NSAIDs, radiation, heavy metals, plant and food poisonings, snake bites, and envenomations.

PO8: Ethics Knowledge: Students will understand the clinical aspects of drug development, such as phases, ethical issues, and the roles and responsibilities of clinical trial personnel. They will also learn about the design of clinical study documents, data management, and safety monitoring in clinical trials.

PO9: Critical and Creative Thinking: Students will participate in in-house scientific and social poster competitions, case study presentations, prescription auditing, and contribute to drug information centers. They will also engage in innovative activities by using creative thinking to envision better ways of accomplishing professional goals.

PO10: Problem Analysis and Learning: Students will provide high-quality, inclusive, evidence-based, patient-centered care in cooperation with patients, prescribers, and members of the interprofessional health care team. They will also influence the development of practice guidelines and evidence-based best practices.

PO11: Solution Provider: Students will develop, integrate, and apply knowledge from the foundational sciences to evaluate the scientific literature, explain drug action, solve therapeutic problems, and advance population health and patient-centered care.

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Course of study for semester I (Pharmacy Practice)

MPP 101T Clinical Pharmacy Practice

Course Outcome Number	Course Outcomes	Cognitive Level
CO1	Recall the key principles and regulations governing the practice of pharmacy, including pharmaceutical care concepts, and the evolution and scope of clinical pharmacy both internationally and nationally.	C1
CO2	Describe the role of clinical pharmacy services including ward round participation, medication order review, and pharmacist interventions, along with the basics of medicine and poison information services, pharmacovigilance, and quality assurance.	C2
CO3	Apply patient data analysis skills, including interpreting case histories, medical abbreviations, and terminologies, and use verbal and non-verbal communication skills in patient care services.	C3
CO4	Analyze lab data including hematological, renal, liver, cardiac disorders, pulmonary and thyroid function tests, as well as fluid and electrolyte balance and microbiological culture sensitivity tests for drug therapy management.	C4
CO5	Evaluate and improve the medication-use process in clinical settings, leveraging medicine information service resources and systematic approaches to answering medicine information queries.	C5
CO6	Develop evidence-based pharmaceutical care plans, integrating drug information, poison information services, and considering patient-specific factors for complex cases.	C6

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MPP 102T **Pharmacotherapeutics-I**

Course Outcome Number	Course Outcomes	Cognitive Level
CO1	Understand the management and treatment of cardiovascular system disorders including hypertension, congestive cardiac failure, acute coronary syndrome, arrhythmias, and hyperlipidemias.	C3
CO2	Understand the management and treatment of respiratory system disorders including asthma, chronic obstructive airways disease, and drug-induced pulmonary diseases.	C3
CO3	Apply clinical pharmacy practices to manage endocrine system disorders including diabetesand thyroid diseases.	C3
CO4	Evaluate and manage gastrointestinal system disorders including peptic ulcer diseases, reflux esophagitis, inflammatory bowel diseases, jaundice & hepatitis, cirrhosis, diarrhea and constipation, and drug-induced liver disease.	C4
CO5	Analyze and propose management strategies for hematological diseases including anemia, deep vein thrombosis, and drug-induced hematological disorders.	C4
CO6	Develop and implement pharmaceutical care plans for bone and joint disorders including rheumatoid arthritis, osteoarthritis, gout, and osteoporosis.	C5

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MPP 103T **Hospital & Community Pharmacy**

Course Outcome Number	Course Outcomes	Cognitive Level
CO1	Understand the basics of hospital and community pharmacy practices including organizational structure, legal requirements, and pharmacy management.	C1
CO2	Comprehend hospital drug policies, formulary guidelines, and the development of therapeutic guidelines.	C2
CO3	Apply principles of drug procurement, inventory control, and drug distribution within a hospital setting.	C3
CO4	Develop skills in medication counseling, understanding prescription requirements, and managing minor ailments.	C4
CO5	Evaluate and contribute to health promotion activities, understand national health programs, and participate in home medicines review programs.	C5
CO6	Perform research in community pharmacy practice, focusing on medication adherence, ADR monitoring, and the role of community pharmacists in health care.	C6

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MPP 104T **Clinical Research**

Course Outcome Number	Course Outcomes	Cognitive Level
CO1	Understand the drug development process, including various approaches to drug discovery and investigational new drug application submission.	C2
CO2	Comprehend ethical principles in biomedical research, familiarize with ethical committee roles, and understand ICH GCP and ICMR guidelines.	C2
CO3	Apply types and designs in clinical research planning, understand phases of clinical trials, and recognize randomization and sampling methods.	C3
CO4	Identify roles and responsibilities of the clinical trial study team, including the investigator, coordinator, sponsor, and CRO.	C3
CO5	Prepare essential clinical trial documents, understand startup activities, and manage investigational product procurement and storage.	C3
CO6	Conduct clinical trial monitoring and close-out processes, ensuring compliance with regulatory requirements and ethical standards.	C4
CO7	Implement quality assurance and control measures in clinical trials, understand the audit process, and manage data effectively.	C4

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MPP 201T Principles of Quality Use of Medicines

Course Outcome Number	Course Outcomes	Cognitive Level
CO1	Understand the definition, principles of Quality Use of Medicines (QUM), key partners, their responsibilities, and the foundational elements in QUM including communication and cost-effective prescribing.	C1
CO2	Describe the concepts in QUM, evidence-based medicine, the importance of essential drugs, and the pharmacist's role in rational drug use.	C2
CO3	Apply QUM principles in various settings including hospital, ambulatory care/residential care, and understand the strategies to promote QUM and its impact on e-health, integrative medicine, and multidisciplinary care.	C3
CO4	Analyze regulatory aspects of QUM in India, understand the regulation of medicines including complementary and OTC medicines, and the professional responsibility of pharmacists.	C4
CO5	Evaluate and manage medication errors, understand the aims and need for pharmacovigilance, the process of ADR detection, reporting, and management, and the pharmacist's role in pharmacovigilance.	C5

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MPP 102T Pharmacotherapeutics II

Course outcome number	Course Outcomes	Cognitive level
CO1	Recall and explain the guidelines for the rational use of antibiotics and surgical prophylaxis in the management of infectious diseases. Describe the pathophysiology and clinical features of infectious diseases such as tuberculosis, meningitis, and respiratory tract infections.	C1
CO2	Understand the pathophysiology and clinical manifestations of dermatological conditions such as psoriasis, scabies, eczema, and impetigo.	C2
CO3	Apply pharmacotherapeutic principles to select appropriate antibiotics for specific infectious diseases.	C3
CO4	Analyze the basic principles of cancer therapy and cancer chemotherapeutic agents. Create a treatment plan for breast cancer and leukemia patients, integrating knowledge of chemotherapy and considering patient-specific factors. Analyze the treatment options for musculoskeletal disorders, including rheumatoid arthritis, osteoarthritis, and gout, considering patient-specific factors.	C4
CO5	Evaluate the selection and use of pharmacotherapeutic agents for the management of dermatological disorders, taking into account patient response and adverse effects. Evaluate the appropriateness of antifungal and antiviral treatments for various fungal and viral infections, considering patient factors and potential drug interactions. Evaluate the pharmacological management of renal disorders, including acute and chronic renal failure, and assess the role of renal dialysis in these conditions. Critically assess and recognize drug-induced renal disorders, suggesting appropriate interventions.	C5
CO6	Develop a comprehensive understanding of the pharmacological management of HIV and opportunistic infections, including the use of antiretroviral therapy.	C6

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MPP 203T Clinical Pharmacokinetics and Therapeutic Drug Monitoring

Course outcome number	Course Outcomes	Cognitive level
CO1	Students will be able to accurately describe and explain the foundational concepts of clinical pharmacokinetics, including the impact of various factors like age, weight, and disease on drug metabolism and the significance of pharmacokinetic drug interactions.	C1
CO2	Students will demonstrate the ability to apply pharmacokinetic principles to design optimal dosage regimens for diverse patient populations, considering various factors like renal and hepatic functions, and integrate knowledge to adapt dosages for patients with specific needs, such as the elderly, pediatrics, and obese patients.	C2
CO3	Students will develop the capability to critically analyze and evaluate the therapeutic drug monitoring (TDM) protocols and pharmacokinetic/pharmacodynamic correlations in drug therapy for managing diverse disease conditions like cardiovascular disease, seizure disorders, psychiatric conditions, and organ transplantations.	C3
CO4	By synthesizing knowledge from different modules, students will be adept at creating individualized, adaptive, and effective drug dosage regimens based on Bayesian theory and population pharmacokinetic data, adjusting for variability due to genetic, age, weight, and interacting drugs.	C4
CO5	Students will acquire proficiency in practically applying the learned principles to adjust dosages in cases of renal and hepatic diseases, taking into account extracorporeal removal of drugs and alterations in pharmacokinetics due to hepatic diseases.	C5
CO6	Learners will be able to comprehend the implications of genetic polymorphism in drug metabolism, transport, and targets, and will integrate pharmacogenetic considerations into pharmacokinetic and pharmacodynamic assessments to optimize therapeutic outcomes.	C6

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MPP 204T **Pharmacoepidemiology & Pharmacoeconomics**

Course outcome number	Course Outcomes	Cognitive level
CO1	Students will be able to Recall the definition and scope of pharmacoepidemiology, List the aims and applications of pharmacoepidemiology,Identify different outcome measures and drug use measures used in pharmacoepidemiology.	C1
CO2	Students will Explain the concept of risk in pharmacoepidemiology. Describe the methods used in pharmacoepidemiological studies, including their theoretical aspects. Differentiate between prevalence, incidence, and incidence rate.	C2
CO3	Students will Apply the measurement techniques for medication adherence. Use various pharmacoepidemiological methods to analyze real-life case studies. Apply the concept of relative risk, attributable risk, and odds ratio to evaluate pharmacoepidemiological data.	C3
CO4	Analyze different sources of data for pharmacoepidemiological studies, including ad hoc data sources and automated data systems. Critically evaluate the strengths and weaknesses of various pharmacoepidemiological methods. Analyze the relevance of pharmacoepidemiology in the context of special applications, such as vaccine safety and hospital pharmacoepidemiology.	C4
CO5	Evaluate the role of pharmacoeconomic evaluations in formulary management decisions. Critically assess the outcomes of different pharmacoeconomic evaluation methods, including cost-minimization, cost-benefit, cost-effectiveness, and cost-utility. Evaluate the significance and implications of pharmacoepidemiology and risk management, especially in relation to drug-induced birth defects.	C5
CO6	Develop a comprehensive understanding of pharmacoeconomics and its historical evolution. Create a pharmacoeconomic evaluation for a specific drug or intervention, considering various outcome assessments. Synthesize the knowledge gained from the course to effectively utilize pharmacoeconomic software and analyze case studies in the context of healthcare decision-making.	C6

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MPP 205P Pharmacy Practice Practical II

Course outcome number	Course Outcomes	Psychomotor Level
CO1	Demonstrate accurate and aseptic drug preparation techniques specific to tuberculosis and meningitis medications, ensuring safe handling and administration.	Imitation (P1)
CO2	Proficiently calculate and administer dosages for antibiotics used in treating respiratory tract infections and gastroenteritis, considering patient weight and condition.	Manipulation (P2)
CO3	Exhibit precise and sterile medication administration skills for patients with endocarditis and septicemia, including intravenous drug administration and monitoring.	Precision (P3)
CO4	Formulate individualized treatment plans for urinary tract infections, protozoal infections (e.g., malaria), and HIV with opportunistic infections, incorporating patient-specific factors and therapeutic considerations.	Articulation (P4)
CO5	Apply critical thinking and evidence-based decision-making in complex cases involving fungal infections, viral infections (e.g., hepatitis), and sexually transmitted diseases (e.g., gonorrhea and syphilis), adapting to evolving patient conditions.	Naturalization (P5)

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