المحتوى الدراسى
للمقررات
مرحلة بكالوريوس
التكنولوجيا الحيوية

بنظام الساعات المعتمدة
كلية التكنولوجيا الحيوية ـ جامعة بدر بالقاهرة
Faculty of biotechnology- Badr university in Cairo

Course Content and Description

1. Human Rights:

عدد ساعات	Course Code:	اسم المقرر
1	UNI 1	حقوق لانسان

Theoretical Part: inherent dignity, equality, freedom, universal, inalienable, fundamental rights, legal protection, international law, United Nations, Universal Declaration of Human Rights, civil liberties, political rights, social rights, economic rights, cultural rights, non-discrimination, right to life, freedom of expression, right to privacy, right to education, right to work, human dignity, social justice, rule of law, accountability, transparency, human development, democracy, civil society, humanitarian law.

2. Scientific Thinking:

عدد ساعات	Course Code:	اسم المقرر
1	UNI 2	Scientific Thinking

Theoretical Part: The course provides meaning and characteristics of thinking, Types of thinking (mythical-emotional), Types of thinking (natural-logical), Types of thinking (critical-scientific), Types of thinking (creative thinking), Administrative writing characteristics, Administrative writing stages, Memorandum & report writing.

3. Problem Solving and Decision-Making Skills:

عدد ساعات	Course Code:	اسم المقرر
1	UNI 3	مهارات حل المشكلات واتخاذ القرار

Theoretical Part: Importance of problem-solving and decision-making skills include the **meaning and characteristics of thinking** encompass cognitive processes that involve reasoning, problem-solving, and decision-making. **Types of thinking** include mythical (influenced by myths and legends), emotional (guided by feelings), natural (rooted in everyday experience), and logical (based on rationality and reason). **Critical-scientific thinking** involves analyzing and evaluating information systematically and rigorously. **Creative thinking** is characterized by originality, innovation, and the ability to generate new ideas. **Definition and**

types of problems range from well-defined (clear objectives and solutions) to ill-defined (ambiguous and complex). **Revision** involves re-evaluating and refining ideas. **Problem-solving techniques** include methodologies such as brainstorming, root cause analysis, and algorithmic approaches. The **decision-making process** entails identifying options, evaluating alternatives, and selecting the best course of action. **Quality and acceptance of the decision** depend on the thoroughness of analysis and stakeholder buy-in. **Types of decision makers** vary from autocratic to collaborative, and **decision-making techniques** include approaches like SWOT analysis, decision trees, and cost-benefit analysis.

4. Information Technology:

عدد ساعات	Course Code:	اسم المقرر
1	UNI 4	تكنولوجيا المعلومات

Theoretical Part: Introduction to Information Technology - overview, role in society, historical evolution. Computer Systems and Architecture - hardware, software, operating systems, components, networks. Data Management and Databases - data storage, retrieval, introduction to database systems, data modeling. Programming and Software Development - programming languages, software development life cycle (SDLC). Web Development and Design - HTML, CSS, JavaScript fundamentals. Network Technologies - network protocols, architecture, security. Information Security and Cybersecurity - cybersecurity threats, vulnerabilities, countermeasures. Systems Analysis and Design - business requirements analysis, system development methodologies. IT Project Management - IT project planning, scheduling, risk management. Emerging Technologies - AI, blockchain, cloud computing. IT Governance and Ethics - ethical, legal implications, governance frameworks. IT in Business and Organizations - IT for business processes, decision-making, organizational strategies.

5. Psychology and Communication Skills:

عدد ساعات	Course Code:	اسم المقرر
1	UNI 5	علم النفس ومهارات التواصل

Theoretical Part: Introduction to Psychology - overview, key concepts and theories; Understanding Human Behavior - influencing factors, genetics, environment, culture; Emotions

and Emotional Intelligence - nature, importance, development; Cognitive Processes and Perception - cognition, biases, impact on communication; Verbal Communication Skills - language skills, active listening, speaking techniques; Nonverbal Communication - body language, gestures, facial expressions; Interpersonal Communication - styles, empathy, assertiveness, conflict resolution; Group Communication and Teamwork - dynamics, strategies, collaboration; Cross-Cultural Communication - cultural differences, sensitivity, adaptation; Communication in Professional Settings - workplace communication, emails, reports, presentations; Communication and Relationships - personal relationships, effective communication skills; Communication and Psychological Well-being - mental health, supportive techniques.

6. Arabic Literature:

عدد ساعات	Course Code:	اسم المقرر
1	UNI 6	الادب العربي

Theoretical Part: Introduction to Arabic literature - historical development, cultural, and linguistic context; Classical Arabic poetry - prominent poets, themes of love, nature, praise, social commentary; Classical Arabic prose - influential works, narrative techniques, storytelling; Islamic literature - religious, philosophical texts, contributions of scholars; Modern Arabic poetry - 19th-century to present, themes of identity, nationalism, social change, political dissent; Modern Arabic prose - novels, short stories, plays, themes of colonialism, gender, social issues, cultural identity; Arabic literature in translation - translated works, translation challenges; Literary movements and themes - Nahda, modernist movement, themes of love, exile, war, social justice; Feminist perspectives - representation of women, works by female writers; Contemporary trends - current developments, engagement with social, political issues.

7. Egyptian History:

عدد ساعات	Course Code:	اسم المقرر
1	UNI 7	التاريخ المصري

Theoretical Part: The Ottoman era in Egypt, French campaign in Egypt, Muhammad Ali and modernization initiative, Egypt during Muhammad Ali's successors, British occupation in 1882, 1919 revolution, Egypt between the wars 1919-1939, 23rd July 1952 revolution.

8. Industrial and Environmental Security:

عدد ساعات	Course Code:	اسم المقرر
1	UNI 8	الامن الصناعي والبيئي

Theoretical Part: The course provides a comprehensive overview of the principles and practices for safeguarding industrial facilities and mitigating environmental risks, emphasizing both theoretical and practical aspects. Topics cover an introduction to the connection between industrial security and environmental protection, identification and mitigation of security threats via risk assessment and management strategies, and implementation of physical security measures such as access control and surveillance systems. The course also delves into cybersecurity for industrial control systems, emphasizing network security and incident response, alongside emergency response planning, coordination with agencies, and hazardous materials management in compliance with safety regulations. It highlights environmental risk assessments, compliance with environmental regulations, waste management, pollution prevention, sustainable practices, and green technologies for resource conservation. Practical components include incident investigation, analyzing root causes, and implementing corrective actions, supplemented with case studies and best practices to illustrate real-world industrial and environmental security challenges, thus equipping students with the necessary knowledge and skills for proactive security and environmental stewardship in industrial operations.

9. Artistic Tasting:

عدد ساعات	Course Code:	اسم المقرر
1	UNI 9	تذوق فني

Theoretical Part: Introduction to different forms of art and art criticism, art history, different periods and styles, interpretation and appreciation of artworks.

10. Music Tasting:

عدد ساعات	Course Code:	اسم المقرر
1	UNI 10	تذوق موسيقي

Theoretical Part: Introduction to different music genres, history of music, music theory, appreciation and critique of music.

11. English I:

عدد ساعات	Course Code:	اسم المقرر
2	F/R-0001	English I

Theoretical Part: Vocabulary for listening & speaking, practicing listening & speaking, Learning new reading & writing skills, Checking listening & speaking skills, Applying listening & speaking skills, Vocabulary for reading & writing, Practicing reading & writing, Checking reading & writing skills, Applying reading & writing skills, For Education (revising & remembering), Daily life (relationships), Work and Business (making decisions).

12. English II:

عدد ساعات	Course Code:	اسم المقرر
2	F/R-0002	English II

Theoretical Part: Vocabulary for listening & speaking, Practicing listening & speaking, Checking listening & speaking skills, Learning new reading & writing skills, Applying listening & speaking skills, Vocabulary for reading & writing, Practicing reading & writing, Checking reading & writing skills, Applying reading & writing skills, For Culture & civilization (rites of passage), Inventions in communications, and Art, East & West literature, Reading Comprehension, Analyzing Literary Genres, Fiction, Non-fiction, Poetry, Drama, Literary Devices, Vocabulary Expansion, Contextual Analysis, Word Roots, Grammar, Syntax, Parts of Speech, Sentence Structure, Verb Tenses, Writing Skills, Organization, Clarity, Coherence, Persuasive Essays, Descriptive Essays, Narrative Essays, Research, Credible Sources, Literary Analysis, Themes, Symbols, Motifs, Critical Analyses, Oral Communication, Group Discussions.

13. Computer I:

عدد ساعات	Course Code:	اسم المقرر
2	F/R-0003	Computer I

Theoretical Part: Introduction to Computers, digital data representation theory, digital data representation examples, computer system architecture, storage systems, input/output devices, operating systems, utility programs, application software, problem-solving techniques, flow charts symbols, sequential flow, decision making, repetition, Computer Systems, Applications, Basic Computer Components, Computer Hardware, Functions of CPU, Memory, Storage, Input/Output

Devices, Computer Architecture, Operating Systems, Functions, Windows, macOS, Linux, Computer Software, System Software, Application Software, Word Processors, Spreadsheets, Presentation Tools, File Management, File Systems, Directory Structures, Organizing Files, Computer Networks, Network Importance, Network Components, Communication Protocols, Internet, Web Browsing, Internet Services, World Wide Web, Search Engines, Programming Concepts, Fundamentals, Programming Languages, Algorithms, Variables, Data Types, Control Structures, Coding, Practical Exercises, Programming Syntax.

14. Computer II:

عدد ساعات	Course Code:	اسم المقرر
2	F/R-0004	Computer II

Theoretical Part: Introduction to HLL, Expressions, Assignment Statements, Decision Making (If Statement), Repetition (Looping: For and While Statements), Arrays, Databases, Database Management Systems, Database Concepts, Key Characteristics of Data, Database Classifications, Database Models, Data Structures and Algorithms (arrays, linked lists, stacks, queues, trees, searching, sorting, algorithm efficiency), Programming Concepts (advanced techniques, object-oriented principles, abstraction, encapsulation, Java/C++/Python), Introduction to Databases (RDBMS, SQL, database operations, design principles, normalization), Software Development Lifecycle (development process, requirements, system design, testing, debugging, maintenance), Introduction to Web Development (HTML, CSS, JavaScript, client-server architecture, web frameworks), Computer Ethics and Security (ethical considerations, cybersecurity, privacy, legal issues).

15. Biosafety:

عدد ساعات	Course Code:	اسم المقرر
2	F/R-0005	Biosafety

Theoretical Part: The **course** covers the importance of biosafety, the role of regulatory agencies, risk assessment, and management of biological materials including microorganisms, viruses, and genetically modified organisms (GMOs). It includes studies on the Hazard Analysis and Critical Control Points (HACCP) system for food safety, prevention of microbial contamination, foodborne pathogens (bacteria, viruses, fungi, and mycotoxins), and ISO methods for predicting foodborne pathogens. Additionally, it explores biotechnology, genetic engineering, the production and associated risks of GMOs, and the regulations governing biosafety.

The practical part (tutorial): involves hands-on activities such as case studies, risk assessment exercises, implementation of HACCP for various scenarios, laboratory techniques for detecting and preventing microbial contamination, and the application of ISO methods. Students will

participate in workshops on genetic engineering techniques and produce GMOs under controlled conditions, followed by assessment of potential risks. There will be practical sessions on navigating the regulatory landscape, ensuring compliance with biosafety regulations, and developing and managing biosafety protocols. By integrating theoretical knowledge with practical applications, this course equips students with the skills necessary for effective biosafety management in various industries.

16. Introduction to Biotechnology:

عدد ساعات	Course Code:	اسم المقرر
2	F/R-0006	Introduction to biotechnology

Theoretical Course: Introduction to Biotechnology course encompasses a comprehensive overview of biotechnology principles, applications, and ethical considerations. It begins with the definition and historical development of biotechnology, Moreover, the course will describe different types of biotechnology and their applications and provide examples of potential advances in biotechnology. Students will learn during the course to understand the pros and cons to biotechnology and many controversial issues in this field. progressing to cellular and molecular biology basics, DNA, RNA, and protein synthesis. The course also covers genetic engineering techniques, such as recombinant DNA technology, and gene cloning. Biotechnology applications in medicine, agriculture, industry, and the environment are explored, emphasizing biopharmaceutical production, GMO crop improvement, biofuel production, and bioremediation. Ethical and regulatory considerations, including genetic privacy and GMO regulations, are discussed, and Forensic Biotechnology types, Animal cloning and Transgenic animals, Aquatic Biotechnology, Bioprospecting, and Bioterrorism. Finally, the course looks at current trends and future perspectives in synthetic biology and nanobiotechnology.

17. Cell Biology:

عدد ساعات	Course Code:	اسم المقرر
4	Bio-1101	Cell biology

Theoretical Part: Cell Biology I offers a comprehensive understanding of cellular structure, function, and organization. The course introduces the student to understand the differences between prokaryotic and eukaryotic cells, plant and animal cell, and understanding the structure and function of non-membranous such as ribosomes, granules and inclusion; single membrane bound organelles such as endoplasmic reticulum, Golgi apparatus, and double membrane bound organelles extending to mitochondria, chloroplast, and nucleus. In addition, topics such as the properties and transport mechanisms of the plasma membrane, cell cycle, mitosis, meiosis, DNA structure, protein synthesis, intracellular trafficking, cytoskeleton, cellular adhesion, the extracellular matrix, apoptosis will be examined.

Practical Part: The course enables the students to practice microscopy exercises to observe cellular structures and their dynamics. Practical sessions will include experiments measuring cellular permeability and cell division observation under different conditions. The course enables the students to understand and practice the different types and techniques of basic Histology and Embryology extending to know the different processes of spermatogenesis, oogenesis, ovulation, fertilization and early developmental stages.

18. Genetics:

عدد ساعات	Course Code:	اسم المقرر
3	Bio-1202	Genetics

Theoretical Part: Principles of genetics, gene structure and function, heredity, genetic variation, Mendelian genetics, Mendel's laws, dominant/recessive traits, incomplete dominance, codominance, lethal genes, multiple alleles, sex-linked inheritance, pedigree analysis, chromosomal inheritance, chromosome structure, sex determination, genetic linkage, recombination, DNA structure/function, RNA, DNA replication, transcription, translation, genetic variation, mutations, genetic drift, gene flow, natural selection, genetic technologies, epistasis, non-allelic interaction, human genome, chromosomal disorders, genetic disorders, autosomal dominant/recessive disorders, X/Y-linked disorders.

Practical Part: Fixation/staining of root tips, mitotic phases observation, plant germ cell staining, meiotic phases, cross lines, punnett squares, pedigree analysis, Mendel's laws problems, F1/F2 generation calculation, chi-square problems, epistatic cases in corn, blood group inheritance, wild type vs. mutant drosophila, colchicine treatment in mice, mice dissection, bone marrow cell extraction, karyotyping, metaphase chromosome staining, chromosome measurement, chromosome arrangement, karyotype report creation.

19. Cell Physiology:

عدد ساعات	Course Code:	اسم المقرر
3	Bio-1203	Cell physiology

Theoretical Part: The course covers topics like cell membrane structure and transport mechanisms (diffusion, osmosis, facilitated diffusion, and active transport), cellular energy metabolism (including glycolysis, Krebs cycle, oxidative phosphorylation, and photosynthesis), and cellular signaling pathways (receptor-ligand interactions, signal transduction, and second messengers). It also delves into the phases of the cell cycle (interphase, mitosis, and cytokinesis), meiosis, regulation of cell cycle checkpoints, maintenance of cellular homeostasis, and the principles of intracellular vesicular transport (endocytosis and exocytosis). Moreover, the course addresses cell adhesion, extracellular matrix, cellular differentiation and specialization, and the impact of cellular dysfunction on human health and disease, including cancer and metabolic disorders.

Practical Part (Tutorial): In the **practical part** of the course, students will engage in laboratory exercises that include microscopy studies to observe and analyze cellular structures and organelles. Hands-on activities will provide experience with various cell transport mechanisms, energy metabolism processes such as glycolysis and oxidative phosphorylation, and cellular signaling assays. Practical sessions will also cover the techniques used to study the cell cycle and division, including flow cytometry and live-cell imaging. Experiments on membrane transport, vesicular trafficking, and cellular responses to environmental stress will help students understand the maintenance of homeostasis. Additionally, laboratory work will include techniques for studying cell adhesion, extracellular matrix, and differentiation processes, with a focus on stem cell culture and differentiation protocols. Case studies and problem-solving activities will emphasize the connection between cellular dysfunction and disease, providing practical insights into the methods used to diagnose and research cell physiology-related disorders.

20. Cellular & Molecular Biology:

عدد ساعات	Course Code:	اسم المقرر
3	Bio-2105	Cellular & Molecular Biology

Theoretical Part: processes governing cell structure, function, and behavior at the molecular level**.** Course topics include: an introduction to cellular and molecular biology, biomolecules, Chromosome structure and function, DNA structure and replication, RNA transcription and translation, gene expression and regulation, cell cycle and division, cellular energy metabolism, membrane transport and signaling, molecular genetics, cell communication, and cell cycle regulation**.** techniques in molecular biology such as Polymerase Chain Reaction (PCR), gel electrophoresis, DNA sequencing, cloning, gene expression analysis, and genetic manipulation techniques, DNA replication and repair are covered.

Practical Part: The practical component involves hands-on experiments, and data analysis exercises to reinforce the theoretical concepts learned in class. Students conduct experiments related to, DNA and RNA total extraction, transcription and translation, gene expression and regulation, and cell cycle checkpoints**.** Techniques employed include PCR, gel electrophoresis, ELISA and DNA sequencing, and gene cloning. thus preparing students to explore advanced topics in molecular biology and related disciplines.

21. Gene Expression:

عدد ساعات	Course Code:	اسم المقرر
4	Bio-2106	Gene Expression

Theoretical part:

This course provides an in-depth exploration of gene expression regulation, which is essential for understanding contemporary life sciences and biotechnology. Students will examine the molecular mechanisms that control gene expression in both prokaryotic and eukaryotic systems, gaining insights into the foundational processes that govern cellular function. Key topics include the impact of epigenetics and transposable elements on gene expression patterns, shedding light on how genetic information is dynamically regulated in response to environmental and developmental cues. The course also addresses the significance of gene expression dysregulation in the context of human diseases, highlighting connections to genetic disorders, cancer, and other conditions. Additionally, students will be introduced to advanced technologies used in gene expression studies, such as high-throughput sequencing and transcriptome analysis, equipping them with essential skills for modern research.

Practical part:

The practical component of this course introduces students to essential techniques in gene expression analysis, starting with RNA extraction, purification, quantification, and electrophoresis to assess RNA integrity. Students will explore RT-PCR and real-time PCR for quantifying gene expression, followed by RNA sequencing for high-throughput transcriptome analysis. Protein-related techniques include extraction, 1D and 2D electrophoresis, and blotting for protein detection. Advanced modules cover microarray and SAGE for large-scale gene expression profiling, and mobility shift assays to study protein-DNA

interactions. These hands-on exercises provide foundational skills for modern research in molecular biology and biotechnology.

22. Immunology:

اسم المقرر	Course Code:	عدد ساعات
Immunology	Bio-2107	3

Theoretical Part: Primary lymphoid organs, secondary lymphoid organs, innate immune system part 1 & 2, lymphocyte development, antigen presentation to BCR and TCR, cell-mediated immunology, humoral-mediated immunology, tolerance, auto-immunity, hypersensitivity, tumor immunology, theoretical revision.

Practical Part: Anatomical examination of lymphoid organ, histological examination of primary & secondary lymphoid organs, dissection, preparation of different blood smear, differential leucocytic count, viability testing of lymphocyte, lymphocytic count in lymph organs, ABO blood typing, agglutination, practical revision.

23. Genetic Engineering:

اسم المقرر	Course Code:	عدد ساعات
Genetic Engineering	Bio-2208	4

Theoretical part:

This comprehensive course explores the fundamental tools and techniques essential for modern genetic engineering. Students will learn about crucial molecular tools including restriction enzymes, DNA ligases, and polymerases, along with their applications in genetic manipulation. The course covers various vector systems for gene cloning and DNA analysis, from basic plasmids to advanced artificial chromosomes (BACs and YACs), emphasizing their unique features and applications. Students will study different cloning strategies and the design of expression vectors for protein production in both prokaryotic and eukaryotic systems. The course also delves into various gene transfer techniques, including physical methods (electroporation, microinjection, biolistics) and chemical approaches (calcium phosphate precipitation, lipofection). Special attention is given to artificial gene transfer methods and the revolutionary CRISPR-Cas9 gene editing system. The course concludes with an overview of gene therapy principles, covering both viral and non-viral delivery systems, and their therapeutic applications in modern medicine.

Practical part:

This laboratory-based course provides comprehensive training in fundamental genetic engineering techniques and their applications in modern biotechnology. Students will master essential molecular biology methods including DNA extraction using CTAB buffer, plasmid miniprep protocols, PCR amplification and purification, and vector-insert manipulation strategies. The course emphasizes hands-on experience with transformation techniques using competent cells, protein analysis through extraction and SDS-PAGE, and the implementation of selective markers for successful cloning. Special attention is given to proper insert orientation verification and modern genome editing applications using CRISPR-Cas9 technology. Through practical laboratory work, students will develop proficiency in these techniques while learning to analyze and troubleshoot experimental results, preparing them for advanced research in molecular biology and biotechnology.

24. Bioinformatics:

عدد ساعات	Course Code:	اسم المقرر
4	Bio-2209	Bioinformatics

Theoretical Part: Introduction to Genomics, information flow in biology, DNA sequence data, experimental approach to genome sequence data, genome information resources, Functional Proteomics, protein sequence, structural data, protein information resources, secondary databases, Computational Genomics, Internet basics, biological data analysis, application, sequence databases, NCBI model, file format, Sequence alignment, database search, protein primary sequence analysis, DNA sequence analysis, pairwise sequence alignment, FASTA algorithm, BLAST, multiple sequence alignment, database searching using BLAST and FASTA, Structural databases, small molecules databases, protein information resources, protein data bank.

Practical Part: Throughout the course, students engage in hands-on experience with widely used bioinformatics software and tools. Practical exercises and assignments are designed to solidify their understanding and proficiency in analyzing biological data sets. Activities include searching and retrieving data from major biological databases like GenBank and UniProt, performing pairwise sequence alignment using algorithms such as Needleman-Wunsch and Smith-Waterman, and conducting database searches using techniques like BLAST and FASTA. Additional laboratory work involves protein structure prediction through homology modeling and ab initio methods, constructing and analyzing phylogenetic trees, and employing bioinformatics tools for functional genomics studies.

25. Pathophysiology:

عدد ساعات	Course Code:	اسم المقرر
3	MdB-2201	Pathophysiology

Theoretical Part: Pathophysiology is an in-depth course aimed at providing students with a comprehensive understanding of the physiological processes and the pathological alterations that lead to disease. The course covers various core topics, such as the basic principles of pathophysiology, cellular and molecular bases of diseases, and mechanisms of homeostasis and cellular adaptation in response to stress and injury. Students will explore the intricate balance of inflammatory processes and immune responses, delve into the Granuloma, Circulatory disturbance, Neoplasia, Blood cardiovascular disease, respiratory disease and understand the pathogenesis and progression of various infectious diseases.

Practical Part: Throughout the Pathophysiology course, students will be well-equipped to analyze cellular and molecular bases of diseases, and mechanisms of homeostasis and cellular adaptation in response to stress and injury. Students will explore the intricate balance of inflammatory processes and immune responses, delve into the Granuloma, Circulatory disturbance, Neoplasia, Blood cardiovascular disease, respiratory disease.. Case studies will form an integral part of the practical experience, allowing students to apply their knowledge in real-world scenarios, critically analyze clinical situations, and interpret diagnostic findings.

26. Biophysics:

عدد ساعات	Course Code:	اسم المقرر
3	NaB-1101	Biophysics

Theoretical Part: The course covers a range of foundational topics, including Structure and Properties of Matter, Introduction to Cellular Biophysics, Body Fluids, Biophysics of Body Fluids, Membrane Potential, Electricity within Biological Systems, Action Potentials and Conduction, Physics of Cardiovascular System, Physics of Vision, Physics of Respiratory System, Introduction to Optics, and Refractive Index.

Practical Part: The practical component of the Biophysics course complements the theoretical learning through hands-on laboratory sessions and problem-solving exercises including Introduction to Laboratory Biophysics, Hook's Law, Young's Modulus, Viscosity Coefficient, Calibration of Thermocouple, and Theoretical.

27. Macromolecular Structures:

عدد ساعات	Course Code:	اسم المقرر
3	PhB-2201	Macromolecular structures

Theoretical Part: The course "Macromolecular Structures" is an advanced exploration into the structural characteristics and properties of macromolecules, including proteins, nucleic acids, and carbohydrates. It combines theoretical lectures and practical tutorials to provide a comprehensive understanding of these biomolecules' functional and biological significance. The course begins with an introduction to macromolecules, emphasizing their importance in biological systems and the hierarchical structure classification (primary, secondary, tertiary, and quaternary). It details protein structure, covering amino acids, peptide bonds, folding, stability, and complex assembly. It also explains nucleic acid structures, including DNA and RNA, base pairing, and their variations affecting gene expression, alongside carbohydrate structures, exploring monosaccharides to polysaccharides and their interactions.

Practical Part (Tutorial): Advanced topics address the challenges in studying membrane proteins and intrinsically disordered proteins, and future directions in structural biology. Practical laboratory sessions and data analysis protein identification, carbohydrate (CHO) identification, enzyme activity, vitamin C determination.

28. Chemistry:

عدد ساعات	Course Code:	اسم المقرر
4	PhB-1202	Chemistry

Theoretical Part: The fundamentals of Solutions, calculations of concentrations of substances, and chemical kinetics, rate of reaction, rate law, first Order and Second order reaction. Analysis of Anions: carbonate group, sulphur, halogen, nitrogen, cyanogen groups. Analysis of Cations: systemic classification of cations. Identification and separation of cations. Quantitative chemical analysis, Acid-Base theory, standard solutions and standard substances, volumetric methods of analysis, ionic equilibrium, volumetric calculations, strengths of acids and bases, indicators, buffer solutions.

Practical Part (Tutorial): Precipitation titrations, complex-formation titration (EDTA) and redox titrations theory, oxidation potentials, Nernest equation. The laboratory sessions involve

qualitative analysis of anions and cations. neutralization titrations, precipitation titrations, complex-formation titration, redox titrations.

29. General Microbiology:

عدد ساعات	Course Code:	اسم المقرر
3	PhB-1203	General Microbiology

Theoretical Part: General Microbiology is an introductory course that provides a comprehensive overview of major groups of microorganisms, including bacteria, viruses, fungi, protozoa, and algae, aiming to develop a fundamental understanding of their morphology, physiology, genetics, ecology. The theoretical content of the course includes the definition and scope of microbiology, historical perspectives, the classification and taxonomy of microorganisms, detailed studies on bacteria, viruses, fungi, and algae, and microbial interactions and ecology. Furthermore, the course covers applied microbiology, focusing on microorganisms in agriculture, food production, industrial applications, and environmental microbiology.

Practical Part (Tutorial): students will learn essential microbiological techniques. These practical sessions include aseptic techniques and laboratory safety, microscopy and staining techniques, and the culturing and identification of microorganisms. Through these sessions, students develop critical technical skills and apply theoretical knowledge to real-world scenarios. Students will possess a solid foundation in general microbiology, equipped with both theoretical knowledge and practical skills necessary for further studies or careers in this field.

30. Organic Chemistry:

عدد ساعات	Course Code:	اسم المقرر
4	PhB-2104	Organic Chemistry

Theoretical Part: This organic chemistry course provides a comprehensive overview of alkanes, alkenes, alkynes, and aromatic compounds, focusing on nomenclature, synthesis, and key reaction mechanisms. Students will study reaction energetics and profiles, isomerism types (including stereoisomerism and geometrical isomerism), and optical isomerism, covering enantiomers, stereomers, meso compounds, and racemic mixtures. Addition and substitution reactions, such as free radical and electrophilic additions, are discussed alongside the principles of Markovnikov's rule and stereochemistry. Alkyl halides are examined through nucleophilic substitutions (SN1 and

SN2) and elimination reactions (E1 and E2). The course also covers the classification and properties of alcohols and ethers, along with aromatic compounds like benzene, exploring concepts such as Kekulé's structure, Hückel's rule, and electrophilic aromatic substitution. This course builds a robust understanding of organic reactions, mechanisms, and compound properties.

Practical Part (Tutorial): This hands-on organic chemistry course offers a practical approach to understanding the behavior and reactions of various organic compound families. Through laboratory experiments, students will explore the properties and reactions of aldehydes, ketones, alcohols, acids, salts of acids, hydrocarbons, amines, and phenols. They will conduct experiments to observe and analyze reactions specific to each compound family, including oxidation and reduction of aldehydes and ketones, esterification of acids, and substitution reactions of alcohols. The course also covers acid-base properties, reactivity, and the synthesis of salts, along with investigations into hydrocarbons and aromatic compounds to understand concepts like electrophilic and nucleophilic substitution. By the end of the course, students will gain hands-on experience in organic chemistry techniques and a thorough understanding of the chemical behavior of these compounds in various reaction environments.

31. Instrumentation:

عدد ساعات	Course Code:	اسم المقرر
4	InB-1101	Instrumentation

Theoretical Part: The course provides first-year undergraduate students with fundamental skills in instrumental chemical analysis and techniques. It covers the classification of instruments based on interactions between molecules, matter, and energy, with an emphasis on using light properties. The course is especially beneficial for students with a background in Biotechnology Sciences who aim to broaden their expertise in various optical and electron microscopy techniques, **chromatography**, and **spectroscopy**. Key topics include **Optical Microscopy**, its components, types, and advantages and disadvantages; **Electron Microscopy**, including SEM and TEM, and their theoretical foundations; and various chromatography techniques such as **Ion-exchange**, **Size-exclusion**, and **High-Performance Liquid Chromatography (HPLC)**, covering their mechanisms, components, and detectors. **Gas Chromatography** and its components and detectors are also discussed. Additionally, the course delves into **Electrophoresis**, including gel

electrophoresis and its applications, as well as analytical techniques for **Qualitative, Quantitative, and Structural Analysis**. Spectroscopy processes like **Absorption, Fluorescence, and Emission** are explained along with their devices and mechanisms. Other advanced topics include **X-Ray Crystallography**, **Raman Spectroscopy**, and the principles of **Centrifugation**.

Practical Part (Tutorial): The course provides students with **practical experience in operating and calibrating scientific instruments** and emphasizes the interpretation of data to reinforce theoretical concepts through real-world applications. By the end of the course, students will have developed a **comprehensive understanding of scientific instrumentation** and the practical skills necessary for maintaining, troubleshooting, and optimizing instrument performance, while ensuring compliance with safety protocols. The course covers a variety of instruments and techniques, including the **pH meter, micropipettes, digital balance, and autoclave**, focusing on their theory, uses, and components. Additionally, the course delves into **chromatography**, exploring its uses and basics, the main components of chromatographic techniques, and the principles and steps involved in paper chromatography. Students will learn about different types of development techniques in paper chromatography and the classification of chromatographic methods. The course also covers types of chromatography, with a focus on **planar chromatography**, which includes both **paper chromatography and thin-layer chromatography**, along with an understanding of the **retention factor (RF)**.

32. Toxicology:

عدد ساعات	Course Code:	اسم المقرر
3	EnB-2101	Toxicology-1

Theoretical Part: The Introduction to Toxicology course provides a comprehensive exploration of toxicology, emphasizing its interdisciplinary nature and the study of adverse effects of chemicals and physical agents on living organisms. In the **theoretical part**, students will be introduced to essential concepts in toxicology, starting with **Introduction to Toxicology** and basic management approaches. They will learn about specific types of toxicities, including those induced by drugs like salicylates, digoxin, iron, and paracetamol, as well as toxic gases, heavy metals, and pesticides. The lectures will also cover topics like toxicities from substances such as cocaine and antidepressants, as well as adverse drug reactions and specific cases of poisoning by ethanol, barbiturates, and opioids. Students will explore toxicities arising from natural sources like animal toxins and plant toxins, and learn about the effects on genetics and teratogenesis and basics of forensic and genetic toxicology.

Practical Part (Tutorial): In the practical part, emphasis will be placed on lab safety protocols and hands-on experience with identifying and managing various toxicological issues through activities like lab investigations, Adverse drug reaction, Ethanol toxicity, Cocaine toxicity, Corrosives toxicity, Tricyclic antidepressant toxicity, Animal toxins, Plant toxins, Barbiturates toxicity, Opioids toxicity & case study). This integration of theoretical knowledge and practical skills ensures that students grasp both the underlying principles of toxicology and their real-world applications.

33. Mathematics:

اسم المقرر	Course Code:	عدد ساعات
Mathematics	NaB-1102	2

Theoretical Part: The Essential Mathematics course is an introductory class designed for learners of all backgrounds, exploring key mathematical concepts, principles, and applications. The course begins with Number Theory, covering integers, rational numbers, prime numbers, factors, exponents, and radicals. It then progresses to Algebra, introducing variables and equations, solving linear equations, and quadratic equations with factoring. Geometry follows, focusing on basic geometric shapes and properties, the Pythagorean theorem, and calculations of area, volume, and surface area. Trigonometry is then examined, with trigonometric ratios, the unit circle, sine, cosine, tangent functions, and their applications. The course continues with Calculus, introducing derivatives and integrals, the Fundamental Theorem of Calculus, and real-life applications. The final unit encompasses Probability and Statistics, covering basic probability principles, statistical measures like mean, median, and mode, and an introduction to probability distributions. The course emphasizes understanding over memorization and connects theoretical concepts with practical applications through weekly quizzes, interactive discussions, and practical sessions, ensuring students gain a solid foundation in mathematics and the ability to apply mathematical concepts across various contexts.

Medical Biotechnology Course Content and Description

34. Human Genome:

عدد ساعات	Course Code:	اسم المقرر
3	Bio-3111	Human genome

Theoretical Part: The Human Genome course provides an in-depth exploration into the structure and function of human chromosomes, including their organization, banding patterns, and significance. It covers various chromosomal abnormalities, both numerical (e.g., trisomy, monosomy) and structural (e.g., deletions, duplications), along with the genetic disorders associated with them. Students learn about the Human Genome Project and its contributions to identifying protein-coding genes and their relationship to diseases. The course delves into gene transcription regulation through cis-acting elements and trans-acting factors, the importance of noncoding RNAs (ncRNAs) like miRNAs, and their roles in gene regulation and implications in medicine. It also examines different types of repetitive DNA, CpG islands, and the significance of copy number variations (CNVs) in phenotypic diversity. Furthermore, the course introduces CRISPR-Cas systems for genome editing, principles behind genome-wide association studies, and the structure and function of human mitochondrial DNA with a focus on maternal inheritance. In addition, computing and data science concepts for analyzing genomic data generated from next-generation sequencing (NGS) are covered.

Practical Part: The practical component of the Human Genome course includes hands-on laboratory exercises and data analysis workshops. Students gain experience in detecting copy number variations (CNVs) through techniques such as fluorescence in situ hybridization (FISH), next-generation sequencing (NGS), and G-band karyotyping. Practical sessions involve the design and execution of CRISPR-Cas9 genome editing experiments, including the use of computer software to design guide RNA (gRNA). Additionally, students will analyze repetitive DNA elements and CpG islands using bioinformatics tools. Workshops focus on interpreting data from genome-wide association studies (GWAS) and understanding their applications in identifying genetic markers for diseases. Through these practical sessions, students develop critical skills in genomic data analysis, including the use of computational tools and data science methodologies to analyze large datasets generated from NGS experiments, preparing them for advanced research in genomics.

35. Cancer Biology:

عدد ساعات	Course Code:	اسم المقرر
3	Bio-3112	Cancer biology

Theoretical part:

This course provides a comprehensive understanding of cancer biology, focusing on the molecular and cellular mechanisms that drive cancer development, progression, and treatment. Topics include the unique characteristics of cancer cells, mechanisms of metastasis, and the roles of chemicals, radiation, and infectious agents in cancer formation. Students will examine oncogenes, tumor suppressor genes, and the pathways they regulate, alongside methods for cancer diagnosis and treatment. Through analysis of current research, students will develop critical thinking skills and explore interdisciplinary perspectives, integrating knowledge from genetics, cell biology, biochemistry, and immunology. Additionally, the course addresses the ethical, societal, and global implications of cancer research, encouraging students to consider cancer's impact on public health.

Practical part:

This Cancer Biology practical course provides hands-on experience in essential techniques for studying cancer at the cellular, tissue, and molecular levels. Students will examine epithelial and connective tissues, perform histochemistry, and identify tumor markers to analyze cancerous changes. They will use flow cytometry to study cell populations, tissue culture to observe cancer cell characteristics, and assess responses to chemicals and radiation. Practical exercises include dissection of a rat as an animal model, an introduction to cancer genomics, and methods for identifying oncogenes and tumor suppressor genes. Diagnostic techniques such as immunohistochemistry, PCR, and drug sensitivity assays further equip students with foundational skills for cancer research and diagnostics.

36. Gene Therapy:

عدد ساعات	Course Code:	اسم المقرر
3	Bio-3213	Gene therapy

Theoretical part:

This Gene Therapy course provides a comprehensive foundation in the principles and strategies of gene therapy, a rapidly advancing area of life science research with significant implications for treating genetic disorders and cancer. Students will explore the types of gene therapy, including gene augmentation and gene silencing, and examine both viral and non-viral vectors used to deliver therapeutic genes. Key topics cover the barriers to effective gene delivery, modern techniques in gene and cell therapy, and the role of stem cells in developing gene therapies. The course also introduces current gene therapies available on the

market, illustrating the impact of innovative technologies in this field. Through a blend of theoretical and practical learning, students will gain insights into how gene therapy aims to correct or treat diseases at the genetic level.

Practical part:

The practical component of the Gene Therapy course offers students hands-on experience with the techniques and methodologies used in the field of gene therapy. Students will begin by learning to work with various gene delivery systems, including both viral and non-viral vectors, through practical exercises in vector design and characterization. They will perform cell culture techniques to assess transfection efficiency and explore gene augmentation and gene silencing strategies using plasmid and RNA interference technologies. Students will also investigate barriers to gene delivery, conducting experiments that evaluate the efficacy of different delivery methods. Additionally, practical sessions will include the use of stem cells in gene therapy applications, allowing students to understand how these cells can be manipulated for therapeutic purposes. Finally, students will analyze current gene therapies on the market through case studies, discussing the technologies employed and their impact on treatment outcomes. This hands-on experience will equip students with the essential skills and knowledge needed for a career in gene therapy research and development.

37. Membrane Biochemistry:

عدد ساعات	Course Code:	اسم المقرر
3	Bio-4117	Membrane biochemistry

Theoretical Part: Membrane Biochemistry is an advanced course that develops an understanding of the basic biophysical processes that are involved in membrane-mediated events and the different families of proteins classified as membrane proteins. Signaling pathways in prokaryotes. Two-component system (TCS). Evolution and TCS in eukaryotes. Basic principles of cell signaling. Characterization of signaling components: signaling molecules, receptors, second messengers, effectors, signaling complexes. Integration and amplification of signals. Basic classification and characterization of membrane receptors. Intracellular/nuclear receptors. Principle of transfer information: post-translation modification of proteins and conformation coupling. Protein phosphorylation/dephosphorylation (protein kinases and protein phosphatases - characterization and classification), oxidation, methylation, acetylation, sumoylation, and ubiquitination. Structural domains and interaction of proteins. Major signaling pathways (SPs): SPs associated with second messengers (Ca^{2+}, cAMP, cADPR, InsP3, DAG,Ptd Ins4,5P2 - signaling, NO/cGMP); redox signaling, MAPK signaling, NF-kB signaling, JAK/STAT signaling, TGF-b/SMAD signaling and Wnt signaling. Cell signaling and apoptosis. Cell cycle control.

Practical Part (Tutorial): The practical part in Membrane Biochemistry provides hands-on exercises and tutorial-based sessions designed to solidify theoretical concepts through real-world

applications. Students will engage in laboratory techniques, case studies, and interactive simulations to explore membrane-mediated events, protein interactions, and cell signaling pathways. This course is ideal for deepening the understanding of biophysical processes, membrane protein functions, and cellular signaling mechanisms critical to cellular processes, disease pathways, and therapeutic applications.

38. Immuno-Chemistry:

عدد ساعات	Course Code:	اسم المقرر
3	Bio- 4218	Immuno-Chemistry

Theoretical Part: The course provides a comprehensive understanding of the principles underlying immune system function and the application of chemical techniques in immunological research. It covers various topics including an overview of the immune system and its components, the structure and properties of antibodies, antigen recognition, and various immunoassay techniques such as ELISA, RIA, and fluorescent immunoassays. It delves into the study of immunogens and haptens, the role of chemical mediators in immune responses, and the principles behind immune system signaling pathways. Theoretical content also includes immunotherapy focusing on immunomodulators, immunological mechanisms of diseases, and the significance of human leukocyte antigens (HLAs). Emerging trends and future directions are discussed, emphasizing cutting-edge research, personalized medicine, and innovative immunotherapies.

Practical Part (Tutorial): encompasses laboratory sessions, case studies, and research projects, providing hands-on experience in applying immunochemical techniques including immune-histochemical techniques. Students will engage in experiments such as conducting ELISA and Western blotting, synthesizing immunological probes, and utilizing molecular imaging techniques. The practical component also includes designing and implementing immunoassays exploring vaccine formulation. By working on research projects, students will analyze biological markers for diagnostic purposes, investigate immunological mechanisms underlying diseases, and apply their findings to therapeutic development. These activities are aimed at equipping students with the skills necessary to integrate immunological knowledge for innovative research and applications in the field of advanced immunology.

39. Molecular Pathology:

عدد ساعات	Course Code:	اسم المقرر
4	Bio-4219	Molecular pathology

Theoretical Part: Molecular Pathology is an advanced course that explores the intersection of molecular biology and pathology, focusing on the molecular mechanisms underlying various diseases. The course provides a comprehensive understanding of molecular pathology, Molecular testing techniques, Molecular biomarkers, Molecular basis of apoptosis, Genetic and epigenetic mutations, Molecular basis of GIT cancer, Molecular basis of neurologic disorders, Molecular basis of genetic disorders.

Practical Part (Tutorial): the course combines laboratory demonstrations and case studies to provide hands-on experience. Students will engage in applying molecular techniques in laboratory sessions, analyzing molecular data, and interpreting results. These practical tutorials aim to equip students with the necessary skills to critically evaluate molecular pathology technique including PCR, Biomarker, apoptosis mechanisms and GIT cancer.

40. Medical Biochemistry:

عدد ساعات	Course Code:	اسم المقرر
4	MdB-3102	Medical biochemistry

Theoretical Part: This course provides a comprehensive overview of medical biochemistry, focusing on the biochemical basis of human diseases. It covers key metabolic pathways, including carbohydrates, lipids, protein, and nucleic acid metabolism. Students will delve into the pathophysiology of various diseases, such as diabetes mellitus, cardiovascular diseases, kidney disorders, liver diseases, and endocrine disorders. The course will also explore the role of enzymes in clinical diagnosis, acid-base balance, electrolyte and mineral balance, and hematology.

Practical Part (Tutorial): The practical component of the course involves hands-on laboratory sessions where students will learn and apply basic laboratory techniques, such as pipetting, spectrophotometry, centrifugation, and electrophoresis. They will analyze clinical samples, interpret laboratory results, and gain experience in quality control and assurance. Case studies will be used to apply theoretical knowledge to real-world clinical scenarios, and group discussions will foster critical thinking and problem-solving skills. Additionally, students may have the opportunity to undertake research projects to investigate specific topics in medical biochemistry.

41. Medical Microbiology:

عدد ساعات	Course Code:	اسم المقرر
4	MdB-3216	Medical microbiology

Theoretical Part: Medical Microbiology is a comprehensive course that delves into the fundamental principles of microbiology applied to medicine, providing an in-depth exploration of various microorganisms, such as bacteria, viruses, fungi, and parasites, and their roles in causing infectious diseases. The course covers topics such as microbial structure and function, mechanisms of microbial pathogenesis, host-microbe interactions, and the immune system's response to infections. Students will study diagnostic techniques, including microscopic and molecular methods, and will learn about major bacterial, viral, fungal, and parasitic infections, along with their clinical presentations and appropriate therapeutic strategies. The course also addresses critical issues like healthcare-associated infections, emerging and reemerging infectious diseases, the principles of vaccines and immunization, and the global challenge of antimicrobial resistance.

Practical Part (Tutorial): the course includes engaging laboratory sessions where students will apply microscopic and staining techniques, culture-based and molecular diagnostic methods to identify microorganisms. They will perform antibiotic susceptibility testing, work with viral, fungal, and parasitic specimens, and assess infection control measures in healthcare settings. Case studies and discussions will provide real-world context to theoretical knowledge, fostering the integration of microbiological principles in clinical practice, epidemiology, infection control, and public health. By the end of the course, students will have gained a comprehensive understanding of medical microbiology, equipped to apply this knowledge in the diagnosis, treatment, and prevention of infectious diseases in various healthcare settings.

42. Molecular Hematology:

عدد ساعات	Course Code:	اسم المقرر
3	MdB-3203	Molecular hematology

Theoretical Part: Molecular Hematology is an advanced course that delves into the study of molecular aspects related to Histology of blood elements, red blood corpuscles, platelets, white blood cells, bone marrow, haemopoiesis, physiology of blood components, RBCs, erythropoiesis, different types of anemia, physiology of platelets, hemostatic functions, platelet disorders, bleeding tendency, drugs affecting hemostasis, pharmacological aspects of anticoagulants.

Practical Part (Tutorial): the course includes laboratory exercises where students get hands-on experience with molecular techniques such as Staining a blood smear, identification of blood elements, identification of bone marrow, hemoglobin estimation, estimation of hematocrit value, blood indices, ESR, assessment of hemostatic function (BT & CT), performing blood grouping, osmotic fragility test..

43. Chromosomes Syndromes

عدد ساعات	Course Code:	اسم المقرر
4	MdB-4106	Chromosomes Syndromes

Theoretical Part: The Chromosome Syndromes course provides an in-depth exploration of various genetic disorders caused by abnormalities in chromosomes, enhancing understanding of the different syndromes, their genetic causes, clinical manifestations, diagnostic methods, and management strategies. The course covers an overview of chromosomes and their role in genetic disorders, types of chromosomal abnormalities, the genetic basis and characteristics of Down Syndrome (Trisomy 21), Turner Syndrome (Monosomy X), and Klinefelter Syndrome (XXY), and chromosomal deletions in Cri du Chat Syndrome (5p-). It delves into physical features, cognitive impairments, diagnostic methods, screening tests, hormone replacement therapy, early interventions, genetic counseling, and support strategies for each syndrome. The content also addresses the genetic mechanisms and chromosomal abnormalities in Prader-Willi Syndrome and Angelman Syndrome, including the neurodevelopmental impairments, behavioral interventions, assistive technologies, and family support and coping strategies. Additional syndromes such as Edwards Syndrome, Patau Syndrome, and Wolf-Hirschhorn Syndrome are briefly outlined regarding their genetic causes, clinical features, and management considerations. The course emphasizes the importance of genetic counseling and psychosocial support, along with current research, emerging therapies, and genetic interventions for comprehensive understanding and future directions.

Practical Part (Tutorial): the course incorporates case studies, interactive discussions, and scientific literature to reinforce theoretical knowledge and provide hands-on experience. Students will engage in diagnostic simulations, analyze genetic data, and participate in role-playing activities to understand the processes and challenges in genetic counseling. Laboratory sessions will involve techniques such as karyotyping, fluorescence in situ hybridization (FISH), and polymerase chain reaction (PCR) to identify chromosomal abnormalities. By the end of the course,

students will be equipped with the skills to recognize, understand, and manage various chromosome-related disorders, contributing to the well-being and support of individuals affected by these syndromes.

44. Prenatal Genetic Diseases

عدد ساعات	Course Code:	اسم المقرر
3	MdB-4207	Prenatal genetic diseases

Theoretical Part: The Prenatal Genetic Diseases course is designed to impart comprehensive knowledge about detectable and diagnosable genetic diseases during pregnancy. The theoretical segment covers the basics of Genetic counseling, Congenital anomalies, Dysmorphology, Prenatal testing, Biochemical screening, Biophysical screening, Noninvasive prenatal testing, Invasive procedures, Down syndrome screening, Assisted reproduction.

Practical Part (Tutorial):the course includes analyzing real-life case studies related to prenatal genetic diseases, allowing participants to apply theoretical knowledge and skills to practical scenarios. Participants will includes Patterns of inheritance, Structural malformations, Basics of ultrasound, Basic statistics, Applications of prenatal biochemical screening, Revision, Rh alloimmunization, Clinical applications of cell-free fetal DNA, Amniocentesis and Chorionic villous sampling, Cordocentesis and Fetal biopsy, Preimplantation genetic diagnosis..

45. Monoclonal Antibody

عدد ساعات	Course Code:	اسم المقرر
3	PhB-4108	Monoclonal Antibody

Theoretical Part: The theoretical part of this course provides the principles about monoclonal antibody technology, production, and applications in research, diagnostics, and therapeutics. It includes the concept and significance of monoclonal antibodies, understanding antibody structure and function, exploring different antibody isotypes, different techniques for producing monoclonal antibodies. It demonstrates the use of monoclonal antibodies in diagnostic assays for detecting diseases and pathogens. In addition, it explains how monoclonal antibodies are used in treating diseases like cancer, autoimmune disorders, and infections. It covers recent advancements in monoclonal antibody design, such as antibody humanization and bispecific antibodies.

Practical Part (Tutorial): It includes the applications of hybridoma technology for monoclonal antibody production. It also familiarizes students with in vitro methods of antibody selection, focusing on the antibody phage display technique. It analyzes case studies and clinical trials to understand the real-world applications and challenges of monoclonal antibody diagnostics and therapies.

46. Cancer Genetics:

اسم المقرر	Course Code:	عدد ساعات
Cancer genetics	Bio-3214	**3**

Theoretical Part: The Cancer Genetics course begins with an introduction to cancer biology and genetics, discussing the genetic and environmental factors influencing cancer development. It delves into the molecular basis of cancer, focusing on mutations and alterations in oncogenes and tumor suppressor genes, and the oncogenic pathways implicated in cancer progression. Furthermore, the course covers inherited cancer syndromes such as BRCA1/2 and Lynch syndrome, emphasizing the importance of genetic testing and counseling for individuals with a family history of cancer. A thorough examination of somatic mutations follows, highlighting their role in cancer initiation and progression and the identification of driver mutations using next-generation sequencing technologies. A segment on cancer genomics explores high-throughput sequencing technologies for genomic profiling and biomarker discovery in various cancer types. The course also addresses epigenetic alterations in cancer, discussing DNA methylation, histone modifications, and non-coding RNAs' impact on gene expression. The study of genomic instability and DNA repair mechanisms in normal and cancer cells, along with defects in DNA repair pathways linked to cancer susceptibility, is included. Additionally, pharmacogenomics and targeted therapies are covered, emphasizing genetic markers predictive of drug response and resistance and personalized medicine approaches in cancer treatment. Topics such as tumor heterogeneity, clonal evolution, and metastasis are examined for their implications on treatment outcomes. The course also includes ethical, legal, and social implications (ELSI) of cancer genetics, addressing privacy, discrimination, and genetic information in healthcare. Finally, future directions in cancer genetics are discussed, focusing on emerging technologies and advancements in precision oncology and targeted therapies.

Practical Part (Tutorial): The practical segment of the Cancer Genetics course includes hands-on training in genetic testing and molecular diagnostics, teaching techniques and methodologies

used in cancer genetic testing. Students will learn to interpret genetic test results and understand their clinical significance through case studies and real-world examples. Practical sessions will cover analyzing and visualizing data from high-throughput sequencing technologies, conducting genomic profiling, and identifying biomarkers in various cancer types. Participants will be trained in the use of bioinformatics tools to analyze epigenetic data, including DNA methylation and histone modification patterns. The course will also provide practical experience in evaluating pharmacogenomics data to predict drug response and resistance, applying personalized medicine strategies in mock clinical scenarios. Through interactive discussions and problem-solving exercises, students will develop skills to address ethical, legal, and social issues in genetic counseling and testing. The practical sessions aim to equip students with the necessary skills to analyze and interpret genetic data relevant to cancer, preparing them for research, clinical practice, or careers in related fields in cancer genetics.

47. Medical Pathology:

عدد ساعات	Course Code:	اسم المقرر
3	MdB-3204	Medical pathology

Theoretical Part: Medical Pathology is an in-depth course that offers a comprehensive understanding of the nature, causes, and effects of diseases and disorders in the human body. The course encompasses the principles of pathology, including the study of cellular and molecular changes, organ systems, and the pathological basis of disease. It starts with an introduction to the field of pathology, its significance in healthcare, and the principles of disease classification and terminology. The course delves into cellular and molecular pathology, examining cellular adaptations, injury, and death, along with the role of genetic and molecular factors in disease development. Students learn about the processes and mechanisms of acute and chronic inflammation, as well as the stages of tissue repair and healing. Immunopathology covers the immune system's role in disease, including immune-mediated diseases, hypersensitivity reactions, and autoimmune disorders. Neoplasia and cancer pathology explore the development, characteristics, and classification of neoplasms, with an understanding of principles such as tumor growth, invasion, and metastasis. The course also covers the pathology of specific organ systems, including cardiovascular (ischemic heart disease, hypertension, heart failure), respiratory (COPD, asthma, lung infections), gastrointestinal (inflammatory bowel disease, peptic ulcer disease, liver diseases), renal (glomerulonephritis, renal failure, urinary tract infections), endocrine (diabetes mellitus, thyroid disorders, adrenal gland disorders), and nervous systems (neurodegenerative

diseases, brain tumors, neuropathies). Additionally, the course addresses laboratory techniques used in pathology, the interpretation of laboratory tests, imaging studies, and diagnostic reports.

Practical Part: The practical component of the Medical Pathology course integrates lectures, case studies, laboratory demonstrations, and interactive discussions to facilitate the practical application of theoretical knowledge. Students engage in analyzing and interpreting pathological specimens, correlating histopathological findings with clinical presentations. Laboratory sessions focus on techniques such as tissue processing, staining, microscopy, and molecular diagnostics. Case studies present real-world scenarios, allowing students to apply their knowledge in diagnosing and managing pathological conditions. Practical demonstrations may include examining slides of various tissues, conducting immunohistochemical staining, and utilizing imaging modalities like MRI and CT scans to visualize pathological changes. Interactive discussions encourage students to critically analyze complex cases, discuss differential diagnoses, and propose appropriate therapeutic strategies. By the end of the course, students will have developed hands-on skills in pathology, enabling them to contribute effectively to the diagnosis and management of diseases in clinical practice.

48. Genealogy:

عدد ساعات	Course Code:	اسم المقرر
3	Bio-3215	Genealogy

Theoretical Part: The course begins by introducing the basics of genealogy, its importance, and the personal and historical significance of tracing one's family history. It covers essential topics including research planning and organization, distinguishing between primary and secondary sources, and identifying and accessing various genealogical records such as birth, marriage, death, and census records. The curriculum extends to exploring vital records, civil registration systems, census and population records, immigration and naturalization records, and military and occupational records. Additionally, learners will delve into online databases and genealogy software, the basics of DNA testing for genealogical purposes, and interpret genetic genealogy results. Understanding newspaper and local history resources, conducting ethnic and religious research, and addressing cultural and religious factors impacting genealogical research are also key components. Lastly, the course emphasizes documenting, preserving, and sharing genealogical research with family members and the wider community.

Practical Part (Tutorial): The practical component of the course involves hands-on activities, case studies, and practical exercises where participants will apply genealogical research techniques. Learners will engage in critical thinking and attention to detail by analyzing real-world genealogical records and interpreting their findings. Tasks include setting research goals,

establishing research plans, organizing findings, utilizing online databases and genealogy software to organize and analyze data, and conducting DNA tests for genealogical purposes. Participants will practice navigating passenger lists, ship manifests, and citizenship records, exploring military and occupational records, and extracting valuable genealogical information from newspaper archives and local records. The course also includes activities focused on documenting and preserving genealogical research and developing strategies for sharing findings with family members and the wider genealogical community. By the end, participants will have acquired the skills and knowledge to uncover their family's history, connect with ancestors, and preserve their heritage for future generations.

49. Pharmacokinetics:

عدد ساعات	Course Code:	اسم المقرر
3	PhB-3205	Pharmacokinetics

Theoretical Part: The Pharmacokinetics course delves into the principles of drug absorption, distribution, metabolism, and elimination, critically important for developing safe and effective drug regimens. Theoretical aspects cover the overview and significance of pharmacokinetics, the impact of administration routes on drug absorption, distribution factors including plasma protein binding, metabolic pathways and enzyme impacts on drug biotransformation, and detailed processes of drug elimination. It includes the interpretation of pharmacokinetic parameters such as bioavailability, volume of distribution, and clearance, as well as Introduction to kinetics, Order of reactions, Introduction to pharmacokinetics, Bioavailability and bioequivalence, Parameters of pharmacokinetics, Classification of pharmacokinetics, and Pharmacokinetic applications. The practical part covers Single IV bolus, Two-compartment models, Multiple IV bolus, Single oral administration, Multiple oral doses, and Infusion doses.

Practical Part (Tutorial): The practical component engages students in case studies, problem-solving exercises, and data analysis to effectively apply pharmacokinetic principles. Students will perform calculations for pharmacokinetic parameters, analyze the impact of different drug administration routes and formulations on absorption, and use pharmacokinetic models to fit data and estimate parameters. They will examine real-life cases to manage drug-drug interactions, interpret genetic information for individualized therapy, and adapt dosing strategies for Pharmacokinetic application of single IV bolus, single IV two compartment, multiple IV bolus, single oral, multiple oral, and infusion doses..

50. Molecular Diagnoses:

عدد ساعات	Course Code:	اسم المقرر
3	Bio-3216	Molecular diagnoses

Theoretical Part: The Molecular Diagnostics of Diseases course provides an in-depth exploration of the principles, methodologies, and technologies used in molecular diagnostics for detecting, diagnosing, and monitoring various diseases at the molecular level. The theoretical component covers an overview of molecular diagnostics and its significance in disease management including Nucleic acid chemistry, DNA replication, PCR optimization for clinical diagnosis, mutations, single nucleotide polymorphisms (SNPs), genetic biomarkers, cell cycle, DNA repair, hemoglobinopathies, PCR for HCV, recombinant DNA technology.

Practical Part (Tutorial): the course includes hands-on laboratory sessions where students will perform molecular diagnostic techniques, including DNA extraction, PCR application techniques, gel electrophoresis, RNA extraction, RFLP (Restriction Fragment Length Polymorphism), RAPD (Random Amplified Polymorphic DNA), AFLP (Amplified Fragment Length Polymorphism), restriction endonucleases, clinical case studies, molecular basis of hemoglobinopathies, PCR for HCV, problem-solving sessions.

51. Cytokines I:

عدد ساعات	Course Code:	اسم المقرر
3	PhB-3206	Cytokines I

Theoretical Part: Cytokines I is an advanced course that delves deeply into the fundamental principles and recent research developments in the area of cytokine biology. Cytokines are critical proteins that are heavily involved in regulating immune responses, inflammation, and other physiological processes. The course offers a comprehensive understanding of the structure and function of cytokines, their signaling pathways, and their therapeutic applications. Key topics include the definition and classification of cytokines, the structure and classification of cytokine receptors, cytokine signaling pathways, and receptor-ligand interactions. The course also covers various cytokine families such as Interleukins (ILs), Tumor Necrosis Factor (TNF) family, and Interferons (IFNs), focusing on their roles in immune regulation, antiviral activities, and inflammation. Furthermore, it examines cytokine production, regulation, and the cellular sources of cytokines. Students will explore cytokines' roles in both innate and adaptive immune responses and understand their involvement in diseases, including cancer, autoimmune disorders, and

infectious diseases. The course also highlights therapeutic applications of cytokines, including cytokine-based therapies and monoclonal antibodies.

Practical Part (Tutorial): The practical component of the Cytokines I course includes hands-on laboratory exercises that allow students to apply theoretical concepts in a real-world setting. Students will engage in experimental methods for studying cytokines, including cell-based assays, enzyme-linked immunosorbent assays (ELISA), flow cytometry, and other molecular techniques. They will also utilize bioinformatics approaches for cytokine analysis and engage in systems-level analysis of cytokine interactions through network modeling and computational approaches. Practical sessions will cover the efficient isolation and purification of DNA and RNA, techniques for analyzing cytokine production, and the use of modern technologies for genetic and genomic testing. Case studies will be employed to illustrate clinical relevance, and students will get opportunities to critically analyze research papers. By the end of the practical sessions, participants will have gained competence in performing cytokine research techniques and interpreting experimental data, preparing them for advanced research or clinical applications in cytokine biology.

a. Drug Resistance:

عدد ساعات	Course Code:	اسم المقرر
3	PhB-3207	Drug resistance

Theoretical Part: The **Drug Resistance course** is meticulously designed to provide a holistic understanding of drug resistance within healthcare and public health frameworks. The theoretical component of the course delves into the **definition and importance of drug resistance**, exploring various types such as **antibiotic, antiviral, antifungal, and antimalarial resistance**, resistant to anticancer, Drug resistant to pediatrics, Geriatrics, pregnancy.

Practical Part (Tutorial): the course engages participants through **discussions and case studies** that reflect real-world scenarios of drug resistance, and antimicrobial drug resistant. Hands-on activities include developing and implementing **antimicrobial stewardship programs**, designing effective **infection prevention and control measures**, and conducting **surveillance and monitoring of resistance patterns**.

52. Forensic Medicine:

عدد ساعات	Course Code:	اسم المقرر

3	MdB-3205	Forensic medicine

Theoretical Part: The Forensic Medicine course delves into the intersection of medicine and law, focusing on the application of medical knowledge to legal investigations. Theoretical components include an overview of forensic medicine's role in the legal system, the historical development of the field, and detailed studies of forensic pathology, clinical forensic medicine, forensic toxicology, forensic anthropology, forensic odontology, forensic entomology, forensic DNA analysis, forensic imaging, forensic psychiatry, and forensic evidence and expert testimony. Additionally, the course covers ethical and legal issues in forensic practice, including professional responsibilities, legal considerations, and courtroom procedures.

Practical Part (Tutorial): the course emphasizes the application of learned concepts through practical exercises, case study analyses, and field visits to forensic laboratories and medical examiner offices. These activities provide hands-on experience in post-mortem examination techniques, evidence collection from living and deceased individuals, toxicological and DNA analyses, estimation of time of death using insect activity, radiological interpretations, and the preparation and delivery of expert testimony. Through these immersive experiences, students gain the practical skills necessary to conduct forensic investigations, analyze evidence, and effectively communicate findings in legal settings.

53. Medical Toxicology:

عدد ساعات	Course Code:	اسم المقرر
3	MdB-4208	Medical toxicology

Theoretical Part: The **Medical Toxicology** course offers an in-depth exploration of toxicology and its medical applications. The theoretical part includes an overview of toxicology, historical perspectives, and the development of medical toxicology as a specialty. It delves into the general principles, such as toxicokinetics and toxicodynamics, which encompass the absorption, distribution, metabolism, excretion, and mechanisms of toxic action at cellular and organ levels. The course addresses toxicological assessment, diagnosis through clinical signs, symptoms, and laboratory findings, and outlines laboratory techniques for toxin detection and quantification. The curriculum covers the management of acute poisonings, emphasizing stabilization, supportive care, decontamination techniques like gastric lavage, and activated charcoal administration. It also provides insights into antidotes and specific treatments for common poisonings, detailing mechanisms of action and administration protocols. Additionally, the course explores toxic effects

on organ systems and management of toxicological syndromes, the impact of environmental toxins on public health, and considerations for pediatric, geriatric populations, pregnancy, and lactation. It includes an introduction to forensic toxicology, relevant analytical techniques like gas chromatography and mass spectrometry, and strategies for prevention and public health initiatives.

Practical Part (Tutorial): students engage in **case studies, practical exercises, and discussions** to apply theoretical principles in various scenarios. This involves hands-on experience in assessing and diagnosing toxic exposures, interpreting screening tests, and performing laboratory techniques. Practical management of poisoned patients is demonstrated, including techniques for decontamination and the administration of antidotes. Students will participate in simulations to recognize and treat toxicological syndromes and complications related to various organ systems. The course will also incorporate practical exercises in identifying and managing toxicological risks in pediatric and geriatric populations, as well as pregnant and lactating women. Analytical toxicology will be practiced through the use of advanced techniques like gas chromatography. Throughout the practical sessions, emphasis is placed on interdisciplinary collaboration, risk assessment, and effective communication skills to manage toxicological emergencies effectively.

54. Metabolic Pathways:

عدد ساعات	Course Code:	اسم المقرر
3	Bio-4220	Metabolic Pathways

Theoretical Part: The Metabolic Pathways course explores the fundamental biochemical processes involved in cellular metabolism, providing a comprehensive understanding of interconnected pathways that convert nutrients into energy and synthesize essential molecules. The theoretical content covers the introduction to metabolic pathways, detailing cellular metabolism and the concepts of anabolism and catabolism. It delves into carbohydrate metabolism, including glycolysis, gluconeogenesis, and the pentose phosphate pathway. The course further examines the citric acid cycle, oxidative phosphorylation, and the electron transport chain, alongside lipid metabolism encompassing lipolysis, fatty acid oxidation, and lipogenesis. Amino acid metabolism topics such as transamination, deamination, the urea cycle, and the synthesis of non-essential amino acids are also discussed. Nucleotide metabolism is addressed through the de novo synthesis and salvage pathways. The course integrates the regulation of metabolic pathways, exploring hormonal regulation, metabolic flux, control mechanisms, and adaptation to physiological states. Additionally, it covers metabolic diseases and disorders resulting from carbohydrate, lipid, and amino acid metabolism dysfunctions, along with an overview of experimental techniques used in metabolism research, including isotope labeling, enzyme kinetics, and metabolomics.

Practical Part (Tutorial): the Metabolic Pathways course includes laboratory sessions where students perform experiments related to Physical and microscopical examination of urine, Chemical examination of urine, Revision, Molarity and Normality, Calibration of automatic pipette, Specimen collection and processing, FBS and PPBS, Oral Glucose Tolerance test, Lipids profile estimation, Serum urea.

55. "Methods in Immunology:

عدد ساعات	Course Code:	اسم المقرر
4	Bio-4221	Methods in Immunology

Theoretical Part: The Methods in Immunology course provides a comprehensive theoretical understanding of laboratory techniques and methodologies used in the study of the immune system. It delves into an overview of the immune system and its components, the principles and applications of various antibody-based techniques such as ELISA, Western blotting, immunohistochemistry, and immunofluorescence. The course also covers the principles and sample preparation protocols of flow cytometry, cell culture techniques including cell isolation, primary culture, and propagation of cell lines, and the use of cell-based assays for studying immune responses. Additionally, it examines molecular biology techniques such as PCR, qPCR, and cloning, as well as a variety of immunoassays like RIA, EIA, fluorescence-based and multiplex assays. Functional assays in immunology, immunogenetics and HLA typing, the use of animal models in immunology research, and the data analysis and interpretation of immunological experiments are also included. The theoretical curriculum highlights the importance of quality control, troubleshooting, and ethical considerations in immunology research.

Practical Part (Tutorial): the course involves hands-on laboratory sessions where students engage directly with the techniques discussed in lectures. These practical sessions include performing ELISA and Western blotting for protein analysis, conducting immunohistochemistry and immunofluorescence for cellular localization studies, and employing flow cytometry for sample preparation, staining, and data analysis. Students practice cell isolation, culture maintenance, and cell-based assays, and carry out molecular biology techniques such as gene amplification using PCR, gene expression analysis using qPCR, and gene cloning. They also perform various immunoassays including radioimmunoassay, enzyme immunoassay, and multiplex assays, along with functional assays like cytokine analysis, proliferation assays, and cell-mediated cytotoxicity assays. Practical work emphasizes the application of statistical analysis, graphical data representation, interpretation of experimental results, quality control practices, and responsible conduct of research. By the end of the practical sessions, students will have developed

significant expertise in essential immunological techniques and the ability to apply these methods to their own immunology research projects.

56. Stem Cells:

عدد ساعات	Course Code:	اسم المقرر
4	MdB-4209	Stem cells

Theoretical Part: The Stem Cells course offers a detailed Introduction to Stem Cells, Embryonic Stem Cells, Perinatal Stem Cells, Adult Stem Cells, Stem Cell Niche, Molecular Characteristics of Stem Cells, Gene Editing and Induced Pluripotent Stem Cells, Stem Cells and Hematological Disorders, Stem Cells in Regenerative Medicine, Stem Cells in Disease Modeling, Stem Cells and Cancer, Stem Cell Banking.

Practical Part (Tutorial): the course is designed to enhance theoretical knowledge through hands-on laboratory experiences and demonstrations. Students will engage in laboratory sessions that cover methods for isolating, culturing, and maintaining stem cells under various conditions. Practical exercises include the generation and reprogramming of iPSCs, conducting functional assays, and exploring growth factors crucial for stem cell maintenance. There are opportunities for students to participate in research projects or analyze case studies, allowing them to apply stem cell biology principles to real-world scenarios and research. Discussions on ethical frameworks and public perception of stem cell research also form an integral part of practical learning, ensuring students understand the societal implications of their work. By the end of the course, students will have developed a comprehensive understanding of stem cell biology and practical proficiency in relevant laboratory techniques.

57. Molecular Therapeutics:

عدد ساعات	Course Code:	اسم المقرر
2	PhB-4209	Molecular therapeutics

Theoretical Part: The **Molecular Therapeutics** course offers an extensive examination of the field of molecular medicine and its therapeutic applications. The theoretical part of the course covers key areas such as the **overview of molecular medicine**, **identification and**

characterization of molecular targets, and the **process of drug discovery and development**. It delves into **molecular drug delivery systems**, emphasizing nanoparticles and liposomes, and addresses **gene therapy**, including gene editing and regulation techniques. The course also discusses **antisense oligonucleotide therapeutics**, **RNA-based therapeutics** such as RNAi and RNA vaccines, and **protein-based therapeutics** like recombinant proteins and monoclonal antibodies. **Immunotherapies** are explored, with a focus on immune checkpoint inhibitors and CAR-T cell therapy. Additionally, the role of molecular diagnostics in personalized medicine, pharmacogenomics, and the various **phases of clinical trials** are examined. Theoretical discussions also cover the **ethical and regulatory challenges** in the field and highlight **emerging trends and future directions**.

Practical Part (Tutorial): the course involves hands-on experiences in techniques such as high-throughput screening and rational drug design, applications of nanoparticles and liposomes in drug delivery, and methods for gene and antisense oligonucleotide therapy. Students will gain experience in RNA interference and the application of RNA-based therapeutic strategies. Laboratory sessions will include protein engineering for therapeutic use and the application of immunotherapies in preclinical settings. Practical activities also cover the design and implementation of preclinical studies, data analysis from molecular diagnostics, and the development of personalized medicine approaches. Case studies and discussions of real-world examples will enhance the understanding of the practical applications and impact of molecular therapeutics in healthcare. By combining theoretical knowledge with practical skills, students will be well-equipped to contribute to the rapidly advancing field of molecular therapeutics.

58. Genomics and Proteomics of Diseases:

عدد ساعات	Course Code:	اسم المقرر
3	MdB-4210	Genomics and proteomics of diseases

Theoretical Part: The course "Genomics and Proteomics of Diseases" provides a detailed exploration of the key concepts and applications in the field of genomics and proteomics and their crucial role in understanding the molecular basis of diseases. It begins with an introduction to Proteomics technologies, data mining tools, protein-protein interactions, Yeast two-hybrid (Y2H) system, protein chromatography, advanced characterization, mass spectrometry, mass spectrometry-based proteomics, post-translation modification, protein function annotation, international annotation web services, and applications

Practical Part (Tutorial): Students will use bioinformatics tools including Epigenetics, database handling, sequencing, primer design, FastQC report generation, proteomic analysis, protein isolation, chromatography techniques, protein detection, protein-protein interaction studies.

59. Medical Biotechnology:

عدد ساعات	Course Code:	اسم المقرر
2	MdB-4211	Medical biotechnology

Theoretical Part: Medical Biotechnology is an advanced course that delves into the applications of biotechnology in medicine, providing an in-depth understanding of the principles, techniques, and ethical considerations in the development and use of biotechnological tools for medical purposes. The theoretical content covers a wide range of topics such as the overview and historical developments in medical biotechnology, genetic engineering and molecular biology techniques including DNA cloning, recombinant DNA technology, gene expression, PCR, DNA sequencing, and genetic manipulation. It also explores biopharmaceuticals and therapeutic proteins, production and purification of recombinant proteins, molecular imaging techniques like MRI, PET, and CT, in vitro diagnostics, genetic testing methods, gene therapy and editing techniques like CRISPR-Cas9, pharmacogenomics, personalized medicine based on genetic profiles, stem cell technology, tissue engineering, regenerative medicine, vaccines and immunotherapy for cancer and immune system disorders, biomedical devices and nanotechnology applications in drug delivery systems, diagnostic tools, biomedical implants, and prosthetics. Additionally, the course discusses ethical and regulatory considerations, the regulatory frameworks governing medical biotechnology, and biotechnology entrepreneurship in healthcare including opportunities and challenges in the industry.

60. Human Reproduction:

عدد ساعات	Course Code:	اسم المقرر
4	MdB-4212	Human reproduction

Theoretical Part: Human Reproduction provides a comprehensive understanding of human reproductive systems and processes. The course covers physiological, anatomical, and hormonal aspects, exploring stages and factors in the reproductive lifecycle. It delves into the anatomy and physiology of the male and female reproductive systems, gametogenesis, fertilization, menstrual cycle regulation, and pregnancy. In addition, the course addresses fertility, contraception,

reproductive health, and aging, encompassing ethical and social implications of reproductive technologies, gene therapy, and emerging trends in reproductive sciences. This theoretical exploration is enhanced by discussions on reproductive rights, justice, and ethical considerations related to contraceptive choices and family planning.

Practical Part (Tutorial): students will engage in hands-on activities including simulations of reproductive techniques like in vitro fertilization (IVF), analyzing case studies on reproductive health disorders, and participating in debates on the ethical implications of reproductive technologies. Laboratory sessions will include the observation of gametogenesis, hormonal assays, and examinations of embryonic development stages. The course employs multimedia presentations for interactive learning and fosters critical thinking through group discussions and research assignments on current advancements in reproductive science. By the end, students will be equipped with practical skills and a thorough understanding of human reproductive biology, reproductive health issues, and the societal impact of reproductive technologies.

Pharmaceutical biotechnology course content and description

32. Phytochemistry

عدد ساعات	Course Code:	اسم المقرر
4	PhB-3110	Photochemistry

Theoretical Part: The Phytochemistry course provides a comprehensive exploration into the diverse chemistry of plant-derived compounds, elucidating their biochemical pathways, roles within plants, and applications across various sectors such as medicine, agriculture, and nutrition. The theoretical component delves into the definition and significance of phytochemistry, including Carbohydrates Introduction, Definition, Biosynthesis, Classification, Physical and Chemical Properties, Structure of Sugars and Stereoisomers, Triose, Tetrose, Pentoses, Sugar Alcohols, Monosaccharides (Glucose, Fructose), Reducing Disaccharides (Lactose, Maltose), Non-Reducing Disaccharides (Sucrose, Sucrose Hydrolysis), Polysaccharides (Starch, Dextrin, Agar, Gum Acacia, Gum Tragacanth), Drugs Containing Carbohydrates, Homopolysaccharides (Starch, Inulin, Dextrin, Cyclodextrin, Dextran, Cellulose, Glycogen), Heteropolysaccharides (Heparin, Hemicellulose, Pectins, Gums, Mucilages), Applications of Carbohydrates (Acarbose, Glucosamine, Chondroitin), Glycosides (Definition, Classification, Hydrolysis, Physical Characters, Extraction, Isolation, Qualitative and Quantitative Estimation), Types of Glycosides (Phenolic, Anthracene, Flavonoid, Cyanogenetic, Thiogenic, Steroidal - Cardiac and Saponin), Volatile Oils Introduction, Methods of Isolation, Chemistry, Pharmacological Properties, Chief Families Containing Volatile Oils.

Practical part: The practical sessions are designed to provide hands-on experience in the extraction, analysis, and characterization of phytochemicals including Quantitative Estimation of Carbohydrates, Videos on Techniques and Principles, Sucrose Hydrolysis, Activities on Carbohydrates in the Pharmaceutical Industry, Practical Exam on Carbohydrates, Phytochemical Screening Techniques, Plant Extract Screening, Glycosides Activity in Pharmaceutical Industry, Volatile Oils Extraction and Isolation (Clevenger Apparatus Demonstration), Phytochemical Screening of Market Herbal Products, Determination of Eugenol in Clove Oil, Determination of Cineol in Eucalyptus Oil, Final Exam with Group Presentations on Phytochemical Screening of Herbal Products.

33. Forensic Pharmacognosy

عدد ساعات	Course Code:	اسم المقرر
3	PhB-3111	Forensic Pharmacognosy

Theoretical Part: The Forensic Pharmacognosy course offers a comprehensive study that combines the principles of pharmacognosy and forensic including Introduction to Forensic Sciences, Forensic Pharmacology, Forensic Botany, Forensic Pharmacognosy & Health Hazards, Pharmacopoeia, Poisonous & Toxic Plants, Classification & Mechanism of Action of Plant Toxins, Toxicological Effects of Plant Toxins, Active Plant Constituents Toxicity (Alkaloids, Glycosides,

Tannins, Essential Oils, Calcium Oxalates), Psychoactive Drugs (Stimulants, Hallucinogens, Depressants, Narcotics, Hypnotics), Plant Poisons (LSD, Mescaline, Myristicin, Psilocybin, Psilocin), Toxicological Case Studies, Essential Oils Toxicity & Treatment, Natural Drugs & Abortion, Water Pollution & Contaminants (Ground Water, Freshwater), Drug Dependence & Narcotics (Opium, Heroin, Cocaine, Caffeine, Cannabis, Nicotine), Chromatography (GC & HPLC) in Forensic Pharmacognosy.

Practical part: students will engage in hands-on activities such as the proper collection and preservation of plant specimens, chain of custody procedures, the Microscope Usage & Slide Preparation, Identification of Plant Hairs (Datura, H. muticus, Belladonna, Digitalis, Nux Vomica), Plant Pollens Identification (Clove, Lavender, Chamomile, Hibiscus), Plant Calcium Oxalates Identification, Plant Fibers & Xylem Vessels Identification, Chemical Tests for Alkaloids (Atropine, Caffeine, Strychnine), Midterm Examination, Preparation & Chemical Identification of Caffeine, Virtual Labs & Videos on Caffeine Toxicity, Analgesics, Psychoactive & Narcotic Drugs, Hallucinogenic Drugs, Drugs causing Abortion, Use of GC & HPLC.

34. Phytotherapy

عدد ساعات	Course Code:	اسم المقرر
4	PhB-3212	Phytotherapy

Theoretical part: The Phytotherapy, or herbal medicine course, offers a holistic approach to healing by leveraging medicinal plants to promote health and treat various ailments. The course delves into the introduction to Phytotherapy, Conventional Medicine, Alternative Medicine, Complementary Medicine, Integrative Medicine, Standardization, Quality Control of Herbal Preparations, Adverse Effects, Dosage Forms, Heart Diseases, CNS Disorders, Herbs for CNS Disorders, Depression, Headache, Parkinson's Disease, Alzheimer's, Dementia, Insomnia, Skin Disorders, Rheumatic Disease, Acne, Hair Disorders, Infected Wounds, Eye Diseases, Glaucoma, Cataract, Sty, Respiratory Tract Disorders, Cough, Bronchitis, Rhinitis, Cold, Flu, Renal System Disorders, Kidney Stones, Urinary Tract Infections, Digestive System Disorders, Dyspepsia, Diarrhea, Constipation, Flatulence, Irritable Bowel Syndrome..

Practical part: Practical sessions in the Phytotherapy course offer hands-on experience in identifying, preparing, and using medicinal plants. Students engage in fieldwork to collect and identify plant specimens based on botanical characteristics and taxonomy. Laboratory sessions focus on Laboratory Safety Instructions, Microscopy, Herbal Preparations, Activity Announcement, Natural Antiseptics (Chamomile, Lavender), Cardio-Protective Herbs (Digitilis leaves, Squill, Ginger, Ginseng), Eye Infection Treatments (Tea bags, Coriander), Respiratory

Treatments (Mentha, Thyme), Herbs for Rheumatic Disease, Herbal Treatments for Cancer, Psoriasis, Vitiligo, Documentation, Practical Demonstrations, Midterm and Final Evaluations.

35. Toxicology 2

عدد ساعات	Course Code:	اسم المقرر
3	PhB-3213	Toxicology-2

Theoretical Part: The course in toxicology begins theoretical aspects of **drug-induced toxicity (Iron + salicylates), drug-induced toxicity (Paracetamol)** cover the mechanisms through which the toxicity occurs, including the overdosing and excessive accumulation of iron leading to oxidative stress, and the metabolism of salicylates that can result in toxicity due to their effects on various systems, such as the central nervous system and gastrointestinal tract. The **basic concepts of forensic toxicology** involve understanding how drugs and toxins are detected and measured in the body, along with the interpretation of these findings for legal purposes. The **drug-drug interaction-induced toxicity-1 and -2** sections investigate how different drugs can interact to enhance toxicity, including pharmacokinetic and pharmacodynamic interactions. Theoretically, it explores how certain herbs can be toxic, the physiological and biochemical mechanisms behind this toxicity, and the symptoms they can cause.

Practical Part (Tutorial): The practical component of the toxicology course includes the practical aspects include understanding the metabolism of paracetamol, primarily through the liver, and recognizing the signs of overdose, such as liver failure. Carcinogenesis focuses on the mechanisms by which normal cells transform into cancer cells, while teratogenesis addresses the factors that cause developmental disorders in embryos. Natural toxins delve into substances produced by organisms that can cause harm, such as snake venom or plant alkaloids. Also, it involves identifying toxic herbs, understanding their proper dosages, and learning about case studies involving herbal toxicity to apply this knowledge in real-world scenarios. This holistic approach ensures that students are well-versed in both the scientific fundamentals and the practical implications of toxicity in various contexts.

36. Addiction & Drug Abuse

عدد ساعات	Course Code:	اسم المقرر
3	PhB-3214	Addiction & Drug abuse

Theoretical Part: The Addiction & Drug Abuse course offers a comprehensive exploration of addiction to psychoactive substances, addressing definitions and distinctions between substance

use, abuse, and Introduction to Drug Abuse, Neurochemistry of Addiction, Alcohol Addiction, Addiction of Over The Counter Drugs, Inhalants Addiction, Athletics Drug Abuse, Opioids Addiction, Plants and Mushrooms of Abuse, Nicotine Addiction, Cocaine & Amphetamine, CNS Stimulants, Hallucinogens, Pregabalin Addiction, Ketamine Addiction.

Practical Part (Tutorial): Students will engage in practical activities including analyzing case studies to identify signs of substance misuse and applying brief intervention techniques. They will participate in role-playing exercises to Introduction to Drug Abuse, Cases on Benzodiazepines & Barbiturates, Benzodiazepines & Barbiturates, Cases on Alcohol Addiction, Cases on Nicotine Addiction, Cases on Pregabalin and Ketamine, Revision of Drug Abuse Topics..

37. Drug Biotechnology

عدد ساعات	Course Code:	اسم المقرر
3	PhB-4121	Drug biotechnology

Theoretical Part: The Drug Biotechnology course encompasses the definition and scope of the field, historical biopharmaceutical developments, and the role of biotechnology in modern drug discovery and development. It covers drug biotechnology, docking and drug target prediction, in silico membrane permeability, homology model and InterProScan of protein, vaccine design antigenic part prediction, antibody prediction and design, protein-protein interaction, PCR, and real-time PCR technology, Fermenter design and fermentation technology.

Practical Part (Tutorial): The course includes laboratory work with Using ChemBioDraw Software, Docking, homology model and membrane permeability, pKa determination of compound, antigenic part prediction (B-cell and T-cell epitopes), antibody prediction and design, protein-protein interaction.

38. Pharmacokinetics

عدد ساعات	Course Code:	اسم المقرر
3	PhB-4122	Pharmacokinetics

Theoretical Part: The Pharmacokinetics course provides a comprehensive exploration of the processes involved in drug absorption, distribution, metabolism, and excretion (ADME). The course covers the principles of pharmacokinetics, including the significance of pharmacokinetics in drug development and personalized medicine. Students will study various routes of drug administration, mechanisms of drug absorption, the impact of protein binding on drug distribution, phases of drug metabolism, and factors influencing drug clearance. Key topics include one-

compartment and multi-compartment models, pharmacokinetic parameters determination, and analysis of drug concentration-time profiles. The theoretical component also addresses therapeutic drug monitoring, pharmacokinetics in special populations, and emerging trends such as physiologically-based pharmacokinetic (PBPK) modeling and biopharmaceutics.

Practical Part: The practical component of the Pharmacokinetics course involves hands-on experiences with pharmacokinetic software and modeling tools for analyzing drug concentration-time profiles and determining pharmacokinetic parameters like the area under the curve (AUC) and clearance (CL). Students will engage in exercises involving dosage adjustments based on therapeutic drug monitoring (TDM) and population pharmacokinetics, considering individual variations and pharmacogenomic data. Practical sessions will also include case studies on drug dosing considerations for pediatric and elderly patients, as well as pregnant and lactating women, enabling students to apply their knowledge to optimize drug regimens and ensure patient safety in clinical settings.

39. Drug Stability

عدد ساعات	Course Code:	اسم المقرر
3	PhB-4221	Drug stability

Theoretical Part: The course on Drug Stability delves into the principles and factors affecting drug stability, covering the significance of stability in pharmaceutical sciences, and the regulatory guidelines for stability testing. Students learn about the chemical, physical, and microbiological factors influencing drug degradation, including light, temperature, humidity, and packaging considerations. The course explores Drug Stability, Factors Affecting Drug Stability, Kinetics of Drug Degradation, Accelerated Stability Studies, Real-Time Stability Studies, Stability-Indicating Assays, Physical Stability of Dosage Forms, Chemical Stability of Drug Substances, Packaging and Container Closure Integrity, Regulatory Requirements and Guidelines, Stability Testing of Biopharmaceuticals, Emerging Trends in Drug Stability.

Practical Part: The practical segment of the Drug Stability course involves hands-on experience in designing and implementing stability protocols for real-time and accelerated stability studies, including Kinetics of Drug Degradation (Determination of the order of reaction), Solve problems on Zero-order reactions, Solve problems on First-order reactions, Solve problems on Second-order reactions, Solve problems on Arrhenius equation and activation energy in stability predictions, Solve problems on degradation rate constants and half-life determination, Solve problems on Arrhenius plot and extrapolation to real-time stability predictions, Development and validation of

stability-indicating analytical methods, Statistical analysis of accelerated stability data, Stability studies for packaging compatibility and container closure integrity, Analytical techniques for characterizing protein stability, Quality by Design (QbD) approaches to stability studies.

40. Pharmaceutics

عدد ساعات	Course Code:	اسم المقرر
3	PhB-4222	Pharmaceutics

Theoretical Part: The pharmaceutics course provides a thorough understanding of the principles and techniques involved in the field, focusing on drug formulation, manufacturing processes, and drug delivery systems. It covers the definition and scope of pharmaceutics within pharmaceutical sciences, Aqueous and non-aqueous liquids, additives and other liquid dosage forms for special use, preparation of liquid dosage forms, suspensions and colloids, emulsions, introduction to solid and semisolid dosage forms, ointments, creams, gels, tablets, capsules, suppositories.

Practical Part: The practical component of the course involves hands-on experience in the formulation and quality control of various dosage forms, including tablets, capsules, and liquid formulations. Students will practice Simple solutions and effervescent solutions, douches with roman numerals, mouthwash and gargles with dose calculation for adults, calamine lotion with dose calculation for children, castor oil emulsion, liquid paraffin emulsion, simple ointment, cold cream and vanishing cream, sunscreen and shaving cream, tablet variations (plain and medicated), tablet preparation, cacao butter suppositories.

41. Medical Microbiology

عدد ساعات	Course Code:	اسم المقرر
4	MdB-4111	Medical Microbiology

Theoretical Part: The course covers the routes of transmission of infectious diseases, outbreak investigation, and the principles of epidemiology. Topics like pathogenesis, clinical manifestations, and the diagnosis of bacterial, viral, fungal, and parasitic infections are included, along with antimicrobial therapies, mechanisms of resistance, and prevention strategies. Theoretical knowledge also covers all type of bacterial infection including Staphylococci, Streptococci,

Neisseria spp., *Corynebacterium diphtheria*, Mycobacteria, Anaerobic non-spore forming bacteria, Anaerobic spore-forming bacteria, Enteric Gram-negative bacilli (*E.coli* & Klebsiella), Salmonella & Shigella,.

Practical Part (Tutorial): Practical sessions include hands-on laboratory work for the classification and identification of microorganisms using microscopy, culture techniques, and molecular methods. Students will perform identification of Staphylococci spp., identification of Streptococci, identification of Neisseria spp., identification of Corynebacterium diphtheria, identification of Mycobacteria, identification of Anaerobic non-spore forming bacteria, identification of Anaerobic spore-forming bacteria, identification of *E.coli* & Klebsiella, identification of Salmonella & Shigella, identification of Pseudomonas and Proteus.

42. Anatomy & Histology

عدد ساعات	Course Code:	اسم المقرر
3	Bio-3122	Anatomy & Histology

Theoretical Part: Epithelial tissue, connective tissue, nervous tissue, muscular tissue, histological structure of nervous digestive system tissues, introduction to comparative anatomy and evolutionary relationships, comparative skeletal systems in vertebrates, comparative respiratory systems in vertebrates, comparative circulatory systems in vertebrates, comparative nervous system.

Practical Part: Histological examination of ectodermal origin tissue, histological examination of endodermal origin tissue (elementary canal part 1), histological examination of endodermal origin tissue (elementary canal part 2), histological examination of endodermal origin tissue (accessories glands), histological examination of mesodermal origin tissue (bones), skeletal system (axial skeleton), skeletal system (appendicular skeleton).

43. Biodegradation and Bioremediation

عدد ساعات	Course Code:	اسم المقرر
4	InB-4102	Biodegradation and bioremadation

Theoretical part:

This advanced course explores the principles and applications of bioremediation as a sustainable solution for environmental pollution. Students will study the fundamental concepts of bioremediation, including

both aerobic and anaerobic biodegradation processes and the microbial mechanisms involved in pollutant degradation. The course delves into cutting-edge bioremediation genomics programs, examining how advanced genomic tools and techniques are revolutionizing our understanding of degradative pathways and organism capabilities. Special emphasis is placed on water bioremediation techniques, including current technologies and emerging solutions for treating contaminated water bodies. Students will explore the powerful applications of genomics in bioremediation, learning how genetic analysis and manipulation can enhance degradation efficiency and develop more effective cleanup strategies. The course features an in-depth study of metagenomic approaches in bioremediation, providing insights into complex microbial communities and their collective degradative capabilities. A significant portion of the course focuses on contemporary challenges such as plastic biodegradation, examining innovative approaches to tackle global plastic pollution. Through detailed case studies of successful bioremediation projects, students will learn to apply theoretical knowledge to real-world environmental challenges. The course combines lectures, discussions, and analysis of current research papers to provide a comprehensive understanding of modern bioremediation technologies.

Practical part:

This laboratory-intensive course provides practical training in microbial bioremediation techniques and processes. Students will gain hands-on experience isolating and characterizing bacteria and fungi with biodegradation capabilities, learning to maintain pure cultures and assess their degradative potential through various screening methods. The course includes practical sessions on measuring biodegradation rates and monitoring microbial growth kinetics during pollutant breakdown. Students will conduct experiments in bioethanol production using different feedstocks, learning fermentation techniques, distillation processes, and yield optimization. Laboratory work extends to biodiesel synthesis, where students will perform lipid extraction, transesterification reactions, and quality testing of the produced biofuel. The course features extensive practical training in heavy metal bioremediation, including isolation of metal-resistant microorganisms, biosorption experiments, and analytical techniques for measuring metal removal efficiency. Students will conduct experiments on hydrocarbon degradation, learning to set up microcosm studies, monitor degradation rates, and analyze breakdown products using chromatographic techniques. The phytoremediation component involves practical work with plant-microbe interactions, including root colonization studies, plant growth promotion assays, and metal accumulation analysis. Each laboratory session emphasizes proper experimental design, data collection, analysis, and interpretation. The course includes training in relevant analytical techniques such as atomic absorption spectroscopy, gas chromatography, and microscopy. Safety protocols for handling hazardous materials and proper disposal methods are strictly enforced.

44. Cytokines II

عدد ساعات	Course Code:	اسم المقرر
3	PhB-3215	Cytokines II

Theoretical Part: The theoretical part of the Cytokines II course encompasses an in-depth study of cytokines and their critical roles in immune regulation and disease processes. It starts with an

overview of cytokines' significance in immunology and elaborates on emerging trends and challenges in cytokine research. Students learn about cytokine families, receptor structures, and signaling pathways, including negative regulation mechanisms. The course examines cytokine production by immune and non-immune cells, factors influencing cytokine expression, and their roles in innate and adaptive immunity. It covers cytokines' contributions to acute and chronic inflammation, their dysregulation in inflammatory diseases, and anti-cytokine therapies. The pathogenesis of autoimmune diseases, immune tolerance, and cytokine-based therapeutic strategies are explored, along with cytokines' roles in tumor development, immune checkpoint inhibitors, and cancer immunotherapy. The response of cytokines to infections, cytokine storms, and their targeting in infectious disease management are also discussed. Additionally, the course addresses cytokines' role in tissue repair, regenerative medicine, and therapeutic applications, including recombinant cytokines, cancer immunotherapy, and immune-related disorders. Finally, it discusses technological advances in cytokine analysis, personalized medicine, and the ethical considerations of cytokine-based therapies.

Practical/Tutorial Part: The practical part includes hands-on laboratory sessions where students conduct experiments related to cytokine production, signaling pathways, and their roles in immune responses. They will engage in molecular techniques to measure cytokine levels, analyze cytokine receptor interactions, and assess cytokine regulation in various immune cells. Students will perform assays to study cytokine-mediated inflammation, autoimmunity, cancer immunotherapy, and infectious disease responses. Experimental design for evaluating cytokine-based therapeutic strategies and recombinant cytokine applications will be included. Tutorials will involve case studies, data analysis, and interpretation of experimental results, enabling students to apply their theoretical knowledge to real-world research and clinical settings.

45. Medical Pathology

عدد ساعات	Course Code:	اسم المقرر
3	MdB-3210	Medical pathology

Theoretical Part: The **Medical Pathology** course delves into the study of disease processes and underlying mechanisms leading to abnormal cellular and tissue changes, providing a deep understanding of pathophysiology, etiology, and clinical manifestations of various diseases. The theoretical aspect covers a wide range of topics including the definition and historical development of medical pathology, cellular adaptations, mechanisms of cell death, inflammation and tissue repair, neoplasia and cancer pathology, cardiovascular, respiratory, gastrointestinal, hepatobiliary, pancreatic, renal, hematologic, endocrine, and metabolic pathologies. Additionally, students will

explore diagnostic techniques such as histopathology, cytopathology, immunohistochemistry, and molecular diagnostics to understand the role of pathology in disease diagnosis and patient care.

Practical (Tutorial) Part: students will engage in laboratory practices involving specimen handling and preparation, microscopic examination of tissue samples for histopathological analysis, and the use of immunohistochemical and molecular diagnostic methods to identify and study disease tissues. Practical tutorials will also include case studies, fostering an integrative understanding of theoretical concepts through hands-on experiences in disease diagnosis and pathological investigations. This comprehensive course equips students for significant contributions in disease diagnosis, treatment, and research, enhancing their capacity to improve patient outcomes and advance medical knowledge.

46. Drug Design

عدد ساعات	Course Code:	اسم المقرر
3	PhB-3216	Drug design

Theoretical Part: The Drug Design course provides an in-depth exploration of the drug discovery process, encompassing historical developments, identification and validation of drug targets, receptor pharmacology, and ligand-receptor interactions. Students will delve into structure-based drug design principles, including molecular modeling, homology modeling, X-ray crystallography, docking, and virtual screening for lead identification. The course covers ligand-based drug design methods such as QSAR modeling, pharmacophore-based design, and pharmacokinetic optimization. Students will also learn about high-throughput screening (HTS) techniques, medicinal chemistry concepts, lead optimization strategies, fragment-based drug design, and computational ADMET prediction. Furthermore, the significance of natural products in drug design, principles for developing biologics and peptide therapeutics, and the focus on specific therapeutic areas such as cardiovascular, CNS, and antimicrobial drug design are addressed. The course concludes with discussions on regulatory considerations, preclinical testing, safety assessment, and emerging technologies in drug design.

Practical/Tutorial Part: Practical components include hands-on experience with computational drug design tools, such as molecular docking and virtual screening software. Students will perform HTS using available compound libraries and develop assays for lead identification. They will engage in SAR analysis, optimize drug-like properties of lead compounds, and conduct fragment screening techniques. Practical sessions will also involve ADMET prediction using in silico models and the isolation and modification of bioactive compounds from natural products. Additional tutorials cover the laboratory techniques for developing biologics, enhancing bioavailability, and formulating drugs for therapeutic use. The course provides experiential

learning through case studies, simulations, and collaborative projects focused on contemporary challenges in drug design and development.

47. Physical Pharmacy

عدد ساعات	Course Code:	اسم المقرر
3	PhB-3217	Physical Pharmacy

Theoretical Part: The theoretical aspect of the Physical Pharmacy course encompasses the definition and scope of physical pharmacy, the role of physicochemical principles in drug development and formulation, and historical developments and milestones in the field. It explores the states of matter (solid, liquid, gaseous) in pharmaceutical systems, intermolecular forces, phase diagrams, and phase transitions pivotal to drug formulation. The course delves into the principles of Orientation to course, States of matter, Surface tension including surface active agents and critical micelle concentration (CMC), Solubility and its expressions, types of solutions, factors affecting solubility of solids in liquids, Colloidal system, Diffusion & Dissolution, Adsorption, Buffer solutions, Henderson-Hasselbach equation, buffer capacity, factors affecting pH of buffer solutions, buffered isotonic solutions, Rheology, Colligative properties, and Partition coefficient..

Practical/Tutorial Part: The practical component of the course equips students with hands-on experience in pharmaceutical calculations essential for compounding and Determination of surface tension, Determination of interfacial tension and calculation of HLB, Determination of CMC, Determination of solubility, Effect of electrolytes on solubility, Effect of surfactants on solubility and determination of CMC by solubility, Determination of adsorbed amount by titration, Problems on buffers and pH, Determination of viscosity, Determination of partition coefficient.

48. Industrial Quality Assurance & Good Manufacturing Practices (GMP)

عدد ساعات	Course Code:	اسم المقرر
3	PhB-3218	Industrial quality assurance & GMP

Theoretical Part: Course Description: Industrial Quality Assurance & Good Manufacturing Practices (GMP) is a specialized course that provides a deep understanding of quality assurance principles and the application of GMP in the pharmaceutical and related industries. Students will learn about introduction to GMP, Current GMP in manufacturing, Organization and personal, Hygiene and sanitation, Premises and facilities, Utilities services, Equipment production and

maintenance, Control of components and materials, Packaging and labeling, Documentation, QC of dosage form.

Practical/Tutorial Part: students will engage in hands-on activities such as the application of GMP regulations in simulated manufacturing environments, conducting internal and external quality audits, performing process validations and equipment qualifications, developing and maintaining documentation including batch records and SOPs, and undertaking risk assessments and mitigation strategies. Practical exercises will also include analytical methods for product quality verification, preparation for regulatory inspections, and implementing corrective and preventive actions (CAPA). These practical experiences will prepare students to contribute effectively to GMP initiation, Manufacturing process under GMP, Organization personal quiz-1, Hygiene, Sanitation, Premises facilities, Premises facilities assignment, Mid-term exam, Utility services, Equipment production maintenance, Control components materials quiz-2, Packaging labeling, Documentation, Dosage form QC.

49. Nutrition & Health

عدد ساعات	Course Code:	اسم المقرر
3	PhB-3219	Nutrition & Health

Theoretical Part: In the theoretical component of the Nutrition & Health course, students will explore the definition and scope of nutrition, Nutrition assessment, Nutrition assessment , Water soluble vitamins, Fat soluble vitamins and minerals, Enteral nutrition, Parenteral nutrition, Nutrition therapy for diabetes mellitus, Nutrition during pregnancy , Nutrition during pregnancy, Acid base balance..

Practical part: In the practical component or tutorial, students will engage in hands-on activities such as Nutrition assessment, Water soluble vitamins, Fat soluble vitamins and mineral, Enteral nutrition, Parenteral nutrition, Nutrition therapy for diabetes mellitus, Nutrition during pregnancy, Complications during pregnancy, Hyperlipidemia and hypercholesterolemia.

50. Pharmacy Practice Experience

عدد ساعات	Course Code:	اسم المقرر
3	PhB-3220	Pharmacy practice experience

Theoretical Part: the *Pharmacy Practice Experience* course includes an introduction to pharmacy practice settings and professional responsibilities. It focuses on developing professional skills and

patient-centered care by covering medication dispensing, prescription processing, patient counseling on medication uses and adherence, and interprofessional collaboration. In community and hospital pharmacy settings, students engage in medication order verification, distribution, patient rounds, medication reconciliation, drug therapy monitoring, and adverse drug reaction reporting. Within ambulatory care and specialty pharmacy practice, students learn chronic disease management and medication therapy management. Clinical pharmacy services encompass drug utilization reviews, formulary management, pharmacokinetic and therapeutic drug monitoring, and evidence-based drug therapy recommendations.

The practical part (tutorial): The practical component includes drug utilization reviews, pharmacokinetic monitoring, and providing evidence-based drug therapy recommendations. Students are also involved in quality improvement initiatives to enhance medication safety. Engaging in patient education sessions, promoting health and wellness, and participating in interdisciplinary team meetings and case conferences form pivotal parts of the practical experience. Additionally, students adapt drug therapy for geriatric and pediatric patients, participate in public health campaigns, and engage in continuous professional development through reflective practice. This integrated practical experience prepares students for various pharmacy careers, ensuring they are equipped with the essential competencies to deliver high-quality patient care and advance pharmacy practice.

51. Plant Tissue Culture

عدد ساعات	Course Code:	اسم المقرر
3	Bio-4224	Plant tissue culture

Theoretical part:

The Plant Tissue Culture course offers students a comprehensive foundation in the principles, techniques, and applications of plant tissue culture. Students will gain both theoretical knowledge and practical skills essential for manipulating plant cells and tissues in controlled environments. Key topics include the roles of macro and micro elements in plant growth, medium composition, plant expression vectors, and plant transformation methods. The course also covers the production of valuable secondary metabolites and the use of bioreactors for scaling up plant tissue culture. By mastering these concepts, students will be prepared to contribute to innovations in agriculture, horticulture, and biotechnology.

Practical part:

The practical part of the Plant Tissue Culture course provides hands-on experience with essential techniques for plant cell and tissue manipulation. Students will prepare culture media with macro and micro elements tailored to support plant growth and development. Practical exercises include plant tissue sterilization,

explant preparation, and culturing techniques for callus formation, organogenesis, and somatic embryogenesis. Students will work with plant expression vectors to perform plant transformation, gaining experience in introducing genetic material into plant cells. The course also includes methods for producing secondary metabolites and an introduction to using bioreactors for scaling up plant tissue cultures. Through these exercises, students will develop critical skills needed for applications in agricultural and biotechnological advancements.

52. Metabolism & Metabolic Control

عدد ساعات	Course Code:	اسم المقرر
3	MdB-4212	Metabolism & Metabolic control

Theoretical Part: Metabolism & Metabolic Control is an advanced course that explores the complex network of cellular energy regulation and metabolic pathways in living organisms, providing a comprehensive understanding of biochemical processes involved in energy generation, utilization, and storage. Through theoretical instruction, students will delve Digestion and absorption of carbohydrates, Glycolysis, Oxidative decarboxylation, Krebs' cycle, Gluconeogenesis, HMP shunt, Glycogen metabolism, Blood glucose, Digestion and absorption of lipids, Lipolysis, Fatty acid oxidation, Synthesis of fatty acids, Ketogenesis, Cholesterol metabolism, Protein metabolism, Catabolism and metabolism of amino acids.

Practical/Tutorial Part: The practical component of the course includes laboratory sessions that involve Physical and microscopical examination of urine, Chemical examination of urine, Molarity and Normality, Calibration of automatic pipette, Specimen collection and processing, FBS and PPBS, Oral Glucose Tolerance Test, Lipids profile estimation, Serum urea and BUN, Revision..

53. Membrane Biochemistry

عدد ساعات	Course Code:	اسم المقرر
3	Bio-4125	Membrane biochemistry

Theoretical Part: Theoretical Part: The advanced course in Membrane Biochemistry provides a comprehensive overview of biological membranes, emphasizing their structure, composition, and functions within cells. Topics include the classification and organization of diverse membrane lipids, membrane fluidity, lipid-protein interactions, and the role of lipid rafts. Students will explore the structure and function of membrane proteins, mechanisms of protein folding and

insertion, and various transport mechanisms such as passive diffusion, facilitated diffusion, and active transport. The course covers cell surface receptors, including GPCRs and tyrosine kinase receptors, and their signaling mechanisms. Key aspects of intracellular membrane compartments, vesicle formation, fusion processes, and the role of membrane trafficking in cellular homeostasis are discussed. Biogenesis of membranes, lipid synthesis, and the roles of the ER and Golgi apparatus in these processes are included. The course delves into membrane dynamics, focusing on curvature generation, fusion and fission processes, and their implications in cellular functions. Additionally, membrane-bound enzymes, metabolic pathways like the electron transport chain, and ATP synthesis are covered. The role of membranes in processes like cellular respiration and photosynthesis, mitochondrial and chloroplast membrane roles, and chemiosmotic coupling are detailed. Membrane-related diseases, their molecular basis, pharmacological targets, and therapeutic strategies are explored. Emerging trends in membrane biophysics, synthetic biology, bioengineering, and applications in drug delivery and nanomedicine are also addressed.

Practical Part (Tutorial): The practical component involves hands-on training in techniques for studying membrane structure and composition, including lipid analysis, protein-lipid interaction assays, and the use of biophysical tools to assess membrane fluidity. Students will perform assays to characterize membrane proteins, study ion transport through patch-clamp techniques, and apply methods for investigating membrane signaling pathways. Laboratory sessions include experiments on vesicle formation, fusion, and trafficking using advanced imaging techniques. Practical exercises in membrane biogenesis and lipid synthesis are conducted, along with studies on membrane remodeling dynamics. Students will engage in analyzing membrane-associated enzymes and metabolic pathways, including techniques to assess cellular energetics. Case studies on membrane-related diseases and therapeutic strategies are also included, with practical sessions on designing experimental approaches to study these diseases. Advanced topics involve using cutting-edge tools in membrane biophysics, synthetic biology, and formulations for drug delivery, providing students with comprehensive laboratory skills in membrane biochemistry.

54. Hematology

عدد ساعات	Course Code:	اسم المقرر
3	PhB-4223	Hematology

Theoretical Part: The comprehensive Hematology course encompasses an overview of hematological sciences, covering the significance of blood and blood disorders within healthcare and their historical developments and milestones. It delves into hematopoiesis, explaining the origin, differentiation, and maturation of blood cells, including erythrocytes, leukocytes, and platelets, alongside the role of hematopoietic stem cells and cytokines. The course elaborates on

the physiology and functions of erythrocytes in oxygen transport, types and causes of anemias, and discusses the immune role of leukocytes, the classification and pathophysiology of leukemias and lymphomas, and their management. Key topics include platelet function in hemostasis, bleeding disorders, the coagulation pathways, and the use of anticoagulants. The genetic and epidemiological aspects of hemoglobinopathies and thalassemias are addressed, with focus on diagnostic approaches and clinical presentations. Further exploration includes hematological malignancies, their classification, diagnostic techniques, and therapeutic interventions such as chemotherapy and targeted treatments. The course also covers principles of transfusion medicine, including donor screening, compatibility testing, and managing transfusion reactions, as well as specific hematological considerations in pregnancy and pediatric patients. Emerging trends in hematology, such as molecular diagnostics, personalized medicine, gene therapy, and the integration of hematology with other medical disciplines, are also highlighted.

Practical (Tutorial) Part: The practical component of the Hematology course equips students with hands-on experience in essential laboratory techniques. Students will learn and practice blood collection methods, including handling and preparation of samples for microscopic analysis. They will prepare and stain blood smears, and perform quality control in laboratory settings. The course includes comprehensive training in conducting and interpreting Complete Blood Counts (CBC), blood coagulation tests, and bone marrow examinations. In addition, students will engage in hemoglobin electrophoresis for diagnosing hemoglobinopathies and thalassemias. Practical sessions on compatibility testing in transfusion medicine and managing donor screenings are included, as well as exercises in diagnosing and managing leukocyte-related disorders, anemia evaluations, and differentiating between hematological malignancies. The laboratory work will ensure that students gain the proficiency needed to contribute effectively to the field of hematology and advance patient care through accurate diagnostics and therapeutic strategies.

55. Stem Cells

عدد ساعات	Course Code:	اسم المقرر
3	MdB-4213	Stem cells **(Pharmaceutical Biotechnology)**

Theoretical Part: This specialized Stem Cells course encompasses a comprehensive exploration of stem cell biology, including the classification and properties of embryonic and adult stem cells, and the significant milestones that have shaped stem cell research. Students will gain insights into Stem Cell Types (totipotent, pluripotent, multipotent, unipotent), Self-Renewal, Differentiation, Embryonic Stem Cells, Isolation Techniques, Pluripotency, Regenerative Medicine, Perinatal Stem Cells, Umbilical Cord Stem Cells, Placenta Stem Cells, Amniotic Fluid Stem Cells, Adult Stem

Cells (hematopoietic, mesenchymal, neural), Stem Cell Niche, Molecular Regulators (Oct4, Sox2, Nanog), Gene Editing (CRISPR/Cas9), Induced Pluripotent Stem Cells (iPSCs), Disease Modeling, Stem Cell Banking, Immunotherapy, Pharmacokinetics, Pharmacodynamics, Drug Discovery.

Practical (Tutorial) Part: The practical component of the course includes laboratory work and hands-on sessions where students will learn techniques for the isolation, culture, and characterization of embryonic and adult stem cells, Ficoll-Hypaque Density Gradient, Magnetic-Activated Cell Sorting (MACS), Fluorescence-Activated Cell Sorting (FACS), Bone Marrow Aspiration, Cord Blood Stem Cell Collection, Cord Tissue Stem Cell Collection, Placenta Stem Cell Collection, Assay of Stem Cells' Potency, Stem Cell Culture, Stem Cell Maintenance, Stem Cell Transplantation Techniques, Gene Editing (CRISPR/Cas9), Establishing Stem Cell Lab/Bank..

56. Animal Cell Culture

عدد ساعات	Course Code:	اسم المقرر
3	MdB-4214	Animal cell culture

Theoretical Part: The Animal Cell Culture course provides a thorough understanding of the principles, techniques, and applications of culturing animal cells in vitro. The course covers the significance of cell culture in biomedical research, historical milestones, and the basic requirements and ethical considerations involved. Students learn about aseptic techniques, laboratory setup, media preparation, and sterilization methods, as well as the selection, authentication, and maintenance of cell lines. Topics include the isolation and establishment of primary cell cultures, the role of growth factors and cytokines in cell proliferation and differentiation, and the application of cell-based assays in drug screening and toxicity testing. The curriculum also explores 3D cell culture systems, tissue engineering, cell differentiation, stem cell culture, bioreactors for large-scale cell culture, and the use of cell culture models in disease research and drug development. Emerging trends such as advances in cell culture technologies, organ-on-a-chip platforms, and future breakthroughs in animal cell culture are also discussed.

Practical Part: In the practical component, students gain hands-on experience with aseptic techniques, preparing and sterilizing cell culture media, and maintaining cell lines. They practice passaging and subculturing cells, monitoring cell viability, proliferation, and confluence, and troubleshooting common issues in cell culture maintenance. The laboratory work includes isolating primary cell cultures from tissues, utilizing growth factors and cytokines in cell-based assays, and performing various cell viability and cytotoxicity tests. Students explore 3D cell culture systems and tissue engineering techniques, induce cell differentiation, and expand stem

cell populations. Additionally, they engage in large-scale cell culture using bioreactors, analyze cell culture models for disease research and drug screening, and work with advanced cell culture technologies and microfluidic platforms. The practical sessions are designed to equip students with the skills necessary to contribute effectively to biotechnology, pharmaceutical research, and cell-based therapy development.

57. Pharmaceutical Chemistry

عدد ساعات	Course Code:	اسم المقرر
3	PhB-4224	Pharmaceutical chemistry

Theoretical Part: Pharmaceutical Chemistry is an in-depth course that explores the principles of drug design, synthesis, and analysis, as well as the relationship between chemical structures and pharmacological activity. The course provides an overview of pharmaceutical sciences and drug development, Antibacterial agents (penicillins, cephalosporins, aminoglycosides and macrolides, tetracyclines and chloramphenicol, sulphonamides, quinolones), Anticancer drugs, Antiviral drugs.

Practical Part (Tutorial): Through hands-on laboratory work and case studies, students will gain practical skills in aseptic techniques, cell culture maintenance, and subculturing. They will perform Limit test for chloride, limit test for sulphate, limit test for iron, limit test for calcium, monograph of ampicillin, monograph of naldixic acid, monograph of busulfan, monograph of zinc sulphate & hydrogen peroxide, brochure activity.