First Year

Proposed Syllabi for all Courses

Prepared by

Abdelmuhsen Abusneina, PhD

March 9, 2023

Syllabus of First Year Courses

Course title: Applied Mathematics	Course Code: BMSC-101

Overall Aims of Course:

Overall Description and Aims: This applied math course in biomedical sciences aims to equip students with the knowledge and skills required for performing mathematical calculations commonly used in clinical laboratories. Students will learn basic arithmetic, rounding numbers, and significant figures; scientific notation and logarithms; systems of measurement; dilutions and titers; molarity and normality; calculations associated with solutions; and basic statistical concepts. The course will also cover quality assurance and quality control in the clinical laboratory instrument.

Intended Learning Outcomes of Course: Upon completion of the course, students will be able to:

1. Understand and apply basic mathematical principles and concepts in clinical laboratory calculations.
2. Analyze and solve mathematical problems related to dilutions, molarity, and normality.
3. Demonstrate proficiency in performing mathematical calculations associated with clinical laboratory procedures.
4. Identify and apply quality assurance and quality control concepts in the clinical laboratory instrument.
5. Apply statistical concepts to evaluate laboratory data and results.

Knowledge and Understanding: Students will have an understanding of the following concepts:

1. Basic arithmetic, rounding numbers, and significant figures.
2. Scientific notation and logarithms.
3. Systems of measurement, including metric and English systems.
4. Dilutions and titers.
5. Molarity and normality.
6. Calculations associated with solutions.
7. Basic statistical concepts.
8. Quality assurance and quality control in the clinical laboratory instrument.

Intellectual Skills:

1. Analyze and solve mathematical problems related to clinical laboratory procedures.
2. Evaluate laboratory data and results using statistical concepts.
3. Apply critical thinking skills to identify potential errors and solutions in clinical laboratory calculations.

Professional and Practical Skills:

1. Perform mathematical calculations accurately and efficiently.
2. Demonstrate proficiency in using laboratory instruments and equipment.
3. Implement quality assurance and quality control protocols in the clinical laboratory instrument.
4. Communicate mathematical concepts and calculations clearly and concisely.

General Transferable Skills:

1. Time management and organization skills.
2. Attention to detail.
3. Problem-solving skills.
4. Communication and presentation skills.
5. Data analysis and interpretation skills.

Course Topics:

1. Basic Arithmetic, Rounding Numbers, and Significant Figures:

- Scientific notation and engineering notation
- Precision and accuracy in measurement
- Rules for significant figures in calculations
- Rounding rules and applications
- Calculation of averages and percentages

2. Scientific Notation and Logarithms:

- Conversion between exponential notation and logarithmic notation
- Use of logarithmic functions in science and engineering
- Calculation of pH and pKa values
- Application of logarithmic functions in signal processing
- Use of logarithmic scales in graphing data

3. Dilutions and Titers:

- Calculation of serial dilutions
- Calculation of dilution factors and concentration
- Use of dilution series in bioassays
- Calculation of titer values
- Calculation of activity and potency in bioassays

4. Molarity and Normality:

- Calculation of molar concentration and dilution
- Conversion between molarity and molality
- Use of mole and gram equivalents in stoichiometry
- Calculation of normality and equivalents
- Application of molarity and normality in titrations

5. Calculations Associated with Solutions:

- Calculation of solution composition and concentration
- Calculation of solubility and saturation
- Calculation of osmolality and osmolarity
- Calculation of colligative properties
- Use of solutions in laboratory techniques and procedures

6. Clinical Chemistry Laboratory:

- Calculation of blood chemistry parameters, such as glucose, cholesterol, and electrolytes
- Calculation of enzyme kinetics and activity
- Calculation of acid-base balance and blood gases
- Calculation of drug levels and therapeutic ranges
- Calculation of reference ranges and quality control parameters

7. Urinalysis Laboratory:

- Calculation of urine chemistry parameters, such as creatinine, protein, and glucose
- Calculation of urine sediment analysis
- Calculation of urine specific gravity and osmolality
- Calculation of urine electrolyte balance
- Interpretation of urine test results and diagnosis of kidney disorders

8. Hematology Laboratory:

- Calculation of blood cell counts and differentials
- Calculation of hemoglobin and hematocrit values
- Calculation of coagulation tests, such as prothrombin time and activated partial thromboplastin time
- Calculation of erythrocyte sedimentation rate and C-reactive protein
- Interpretation of blood test results and diagnosis of blood disorders

9. Immunohematology Laboratory:

- Calculation of ABO and Rh blood types and compatibility testing
- Calculation of antibody titers and cross-matching
- Calculation of red blood cell indices and morphology
- Interpretation of blood bank test results and selection of blood products
- Calculation of blood transfusion reactions and troubleshooting

10. Microbiology Laboratory:

- Calculation of microbial growth and inhibition, including minimum inhibitory concentration (MIC)
- Calculation of colony-forming units and bacterial enumeration
- Calculation of antimicrobial susceptibility testing
- Interpretation of microbial test results and diagnosis of infectious diseases
- Calculation of infection control parameters and outbreak investigation

11. Molecular Diagnostics Laboratory:

- Calculation of DNA and RNA concentrations and purity
- Calculation of PCR reaction components and conditions
- Calculation of gel electrophoresis parameters
- Interpretation of molecular diagnostic test results
- Calculation of gene expression and mutation analysis

12. Quality Assurance in the Clinical Laboratory:

- Calculation of control charts and trends
- Calculation of standard deviation and coefficient of variation
- Calculation of method comparison and bias
- Calculation of uncertainty of measurement
- Interpretation of quality control data and troubleshooting

13. Basic Statistical Concepts:

- Calculation of probability and statistical distributions
- Calculation of hypothesis testing and p-values
- Calculation of confidence intervals and sample size
- Calculation of correlation and regression analysis
- Interpretation of statistical results and reporting of findings

14. Quality Assurance and Quality Control in the Clinical Laboratory:

- Calculation of accuracy and precision
- Calculation of total error and uncertainty
- Calculation of interlaboratory comparison and proficiency testing
- Calculation of method validation and verification
- Interpretation of quality assurance data and reporting of findings

15. Instrument Calibration and Maintenance:

- Calculation of calibration curves and standards
- Calculation of linearity and range of an instrument
- Calculation of detection limits and sensitivity
- Calculation of instrument drift and stability
- Interpretation of instrument calibration data and troubleshooting

Tutorial:

- Familiarization with laboratory techniques and equipment
- Practice of basic and advanced calculations related to laboratory procedures
- Interpretation and analysis of laboratory results
- Troubleshooting and problem-solving skills development
- Development of teamwork and communication skills

Examples:

1. Calculation of enzyme kinetics: This subtopic can cover the basic principles of enzyme kinetics, and how to calculate important parameters such as Km, Vmax, and enzyme activity.
2. Pharmacokinetics calculations: This subtopic can cover the principles of pharmacokinetics and how to calculate important parameters such as clearance, volume of distribution, and half-life.

3. Calculation of molecular biology techniques: This subtopic can cover the mathematical principles involved in common molecular biology techniques, such as PCR, gel electrophoresis, and DNA sequencing.
4. Biostatistics: This subtopic can cover basic statistical concepts such as probability, hypothesis testing, regression analysis, and ANOVA, and their applications in biomedical research.
5. Modeling and simulation in biomedical research: This subtopic can cover the principles

2	Course title: Computer Skills	Course Code: BMSC-102

Overall Description and Aims:

The Computer Skills course is designed to equip students with the fundamental computer skills necessary to support their future studies and careers in biomedical science. The course is designed to be hands-on and practical, with a focus on developing the essential computer skills and knowledge required to perform basic data analysis, scientific communication, and information management tasks in biomedical research. The primary aim of the course is to provide students with a foundation in computer skills, tools and concepts necessary for their future academic and professional development. Through a combination of lectures, lab exercises and assignments, students will develop the ability to effectively use a range of software applications for data analysis, visualization, communication and project management.

Intended Learning Outcomes: The course is designed to provide students with the following learning outcomes:

Knowledge and Understanding:

- Basic concepts of computer hardware and software
- Principles of data management and analysis in biomedical science
- The use of databases and data management tools
- The principles and techniques of scientific communication and scientific writing
- The basics of programming languages, algorithms, and software development

Intellectual Skills:

- The ability to analyze and interpret data using computer software
- The ability to critically evaluate scientific literature and experimental results
- The ability to design, develop, and implement basic software applications
- The ability to work independently and solve problems using computer-based tools

Professional and Practical Skills:

- Effective use of computer software for data analysis and visualization
- Management of scientific literature and data using databases and other software tools
- Creation of clear and concise scientific presentations, posters and reports
- Understanding and following ethical principles in the use of computer software and data management

General Transferable Skills:

- Effective communication skills, both written and oral

- Critical thinking and problem-solving skills
- Time management and project management skills
- Teamwork and collaboration skills

Course Topics :

1. Knowing computer:

- Understanding the different types of computers (desktops, laptops, tablets, etc.)
- Identifying the basic components of a computer (CPU, RAM, hard drive, etc.)
- Operating systems and their functions (Windows, Mac OS, Linux, etc.)
- Peripheral devices (keyboard, mouse, printer, scanner, etc.)
- Computer maintenance and troubleshooting techniques

2. Operating computer using GUI-based operating system:

- Understanding the desktop and user interface
- Basic file management (creating, saving, renaming, deleting files)
- Customizing desktop settings
- Installing and uninstalling software
- Using built-in applications (calculator, notepad, etc.)

3. Understanding word processing:

- Formatting text (font, size, color, alignment)
- Working with tables and lists
- Creating headers and footers
- Inserting and formatting images
- Using mail merge for bulk mailings

4. Using spreadsheet:
- Data entry and manipulation
- Formulas and functions
- Sorting and filtering data
- Creating charts and graphs
- Working with multiple worksheets

5. Using internet:
- Understanding web browsers (Chrome, Firefox, Internet Explorer, etc.)
- Using search engines (Google, Bing, etc.)

- Evaluating website credibility and reliability
- Online communication tools (email, chat, etc.)
- Downloading and uploading files

6. Communications and collaboration:

- Effective email communication techniques
- Using online collaboration tools (Slack, Trello, Asana, etc.)
- Virtual meeting etiquette
- Project management and task delegation
- Effective communication strategies for remote teams

7. Making presentations:

- Creating and formatting slides
- Using multimedia (images, videos, audio)
- Presenting to different audiences (technical vs. non-technical)
- Public speaking and presentation skills
- Incorporating feedback and critique

8. Image editing:

- Basic image editing techniques (cropping, resizing, rotating)
- Color correction and adjustments
- Working with layers and masks
- Advanced editing techniques (cloning, compositing)
- File formats and compression techniques

9. Graphics and multimedia:

- Creating and editing graphics (logos, icons, etc.)
- Creating and editing videos (cutting, merging, adding effects)
- Audio editing techniques (trimming, adjusting volume)
- Design principles (color theory, typography, layout)
- Creating engaging multimedia content for different platforms (web, social media, etc.)

11. Data organization and management:

- Structuring and organizing data
- Importing and exporting data from different sources
- Creating backups and disaster recovery plans

12.Statistical analysis software:

- Introduction to statistical analysis software (SPSS, R, etc.)
- Data cleaning and preparation
- Descriptive statistics (mean, median, mode, standard deviation, etc.)
- Inferential statistics (t-tests, ANOVA, regression

13.Cybersecurity basics:

- Understanding common cyber threats (phishing, malware, etc.)
- Best practices for password management
- Basic network security (firewalls, VPNs, etc.)
- Understanding encryption and data protection techniques
- Incident response and disaster recovery planning

14.Programming basics:

- Introduction to programming languages (Python, Java, C++, etc.)
- Data types and variables
- Control structures (loops, conditions, etc.)
- Functions and modules
- Debugging and error handling

3	Course title: Cytology and Histology	Course Code: CYTO-103

Overall Description and Aims:

The course is designed to provide students with an understanding of the microscopic structure and function of cells, tissues, and organs. This course aims to provide students with the necessary knowledge and skills to conduct and interpret basic microscopic techniques, Through this course, students will develop knowledge and skills that are essential to analyze and interpret microscopic structures .

Intended Learning Outcomes:

Knowledge and Understanding:

1. Understand the cellular, and tissue-level organization of the human body.

2. Identify the structures and functions of cell organelles, including the nucleus, mitochondria, and endoplasmic reticulum.
3. Describe the processes involved in cell division and cell differentiation.
4. Identify the main types of tissues in the human body and their functions.

Intellectual Skills:

1. Analyze and interpret microscopic structures, tissue sections and their functions.
2. Evaluate and interpret data from cytological and histological studies.

Professional and Practical Skills:

1. Conduct laboratory experiments and record data accurately.
2. Use imaging techniques such as light microscopy and electron microscopy to study cells and tissues.
3. Operate and troubleshoot different types of microscopes.
4. Analyze and interpret data from histological experiments and studies.

General Transferable Skills: 16. Communicate effectively in written and oral formats.

1. Work effectively in a team and collaborate with others.
2. Manage time and resources effectively.
3. Develop critical thinking and problem-solving skills.
4. Demonstrate adaptability and flexibility in response to changing circumstances.

Course topics:

1. Introduction to Cytology and Histology:

- Understand the basic principles and techniques of cytology and histology

2. Cell Structure and Function:

- Understand the structure and function of cells, including organelles and membrane systems

3. Cell Staining:

- Understand the principles and applications of cell staining techniques

4. Light Microscopy:

- Understand the principles and applications of light microscopy

5. Electron Microscopy:

- Understand the principles and applications of electron microscopy

6. Tissue Preparation and Processing:

- Understand the principles and applications of tissue preparation and processing

7. Epithelial Tissue:

- Understand the structure and function of epithelial tissue, including different types and their functions

8. Connective Tissue:

- Understand the structure and function of connective tissue, including different types and their functions

9. Muscle Tissue:

- Understand the structure and function of muscle tissue, including different types and their functions

10. Nervous Tissue:

- Understand the structure and function of nervous tissue, including different types and their functions

11. Blood and Blood Cells:

- Understand the structure and function of blood and blood cells

12. Lymphatic System:

- Understand the structure and function of the lymphatic system, including lymph nodes and vessels

13. Bone Tissue:

- Understand the structure and function of bone tissue, including different types and their functions

14. Cartilage Tissue:

- Understand the structure and function of cartilage tissue, including different types and their functions

15. Adipose Tissue:

- Understand the structure and function of adipose tissue, including different types and their functions

24. Skin Histology:

- Understand the histology of the skin, including different layers and cells involved in protection and sensation

25. Eye and Ear Histology:

- Understand the histology of the eye and ear, including different tissues and cells involved in vision and hearing

Practical Classes and Objectives:

Microscopy

- Light microscopy: Understanding the basic principles of light microscopy, including brightfield, phase-contrast, and fluorescence microscopy, and their applications in cytology and histology.
- Electron microscopy: Understanding the basic principles of electron microscopy, including transmission electron microscopy and scanning electron microscopy, and their applications in cytology and histology.

Epithelial tissue:

- Different types of epithelial tissue: Understanding the differences between simple, stratified, pseudostratified, and transitional epithelial tissues, including their location in the body.

- Epithelial cell structure: Understanding the cellular structure of epithelial cells, including the apical and basal surfaces, tight junctions, and desmosomes.

Connective tissue:

- Different types of connective tissue: Understanding the differences between loose, dense, cartilage, bone, and blood connective tissues, including their location in the body.
- Connective tissue cells: Understanding the different cells that make up connective tissue, including fibroblasts, chondrocytes, osteocytes, and blood cells.
- Connective tissue fibers: Understanding the different types of fibers that make up connective tissue, including collagen, elastin, and reticular fibers.

Muscle tissue:

- Different types of muscle tissue: Understanding the differences between skeletal, smooth, and cardiac muscle tissue, including their location in the body.
- Muscle cell structure: Understanding the cellular structure of muscle cells, including the sarcomere and the sliding filament theory.

Nervous tissue:

- Different types of nervous tissue: Understanding the differences between neurons and glial cells, including their location in the body.
- Nervous cell structure: Understanding the cellular structure of neurons, including dendrites, axons, and synapses.

Bone Tissue:

- Understanding the histological features of bone tissue, including the extracellular matrix, osteoblasts, osteocytes, and osteoclasts.
- Understanding the different types of bone tissue, including compact bone and spongy bone, and their locations in the body.
- Understanding the process of bone formation, including intramembranous and endochondral ossification.

Cartilage Tissue:

- Understanding the structure and function of cartilage tissue, including different types such as hyaline, elastic, and fibrocartilage, and their locations in the body.
- Understanding the extracellular matrix of cartilage tissue, including collagen and proteoglycans, and their roles in maintaining tissue integrity and mechanical properties.
- Understanding the process of chondrogenesis, including the differentiation of mesenchymal cells into chondrocytes and the secretion of extracellular matrix.

Adipose Tissue:

- Understanding the structure and function of adipose tissue, including different types such as white, brown, and beige, and their locations in the body.
- Understanding the roles of adipose tissue in energy storage, thermogenesis, and endocrine signaling.

Skin Histology:

- Understanding the structure and function of skin tissue, including the epidermis, dermis, and subcutaneous layer, and their components such as hair follicles, sweat glands, and sensory receptors.
- Understanding the histological features of the epidermis, including keratinocytes, melanocytes, and Langerhans cells, and their roles in protection and immune response.
- Understanding the histological features of the dermis, including fibroblasts, collagen, and elastic fibers, and their roles in mechanical support and wound healing.
- Understanding the process of skin regeneration, including the proliferation and differentiation of epidermal stem cells and the synthesis of extracellular matrix in the dermis.

4	Course title: Fundamentals of Biochemistry	Course Code: MLSC-101

Overall Description and Aims:

The course is designed to provide students with a comprehensive understanding of the basic principles of biochemistry. The course aims to introduce students to the structure and function of biomolecules, metabolic pathways, and the principles of gene expression.

Intended Learning Outcomes: Upon completion of the Fundamentals of Biochemistry course, students will be able to demonstrate the following:

Knowledge and Understanding:

- Describe the structure, function, and metabolism of biomolecules such as carbohydrates, lipids, proteins, and nucleic acids
- Explain the basic principles of enzyme kinetics and catalysis
- Describe the major metabolic pathways in the cell, including glycolysis, the citric acid cycle, and oxidative phosphorylation
- Understand the principles of gene expression, including DNA replication, transcription, and translation

Intellectual Skills:

- Analyze and interpret biochemical data and experimental results
- Apply critical thinking to evaluate and solve complex biochemical problems
- Develop hypotheses and design experiments to test them

Professional and Practical Skills:

- Communicate scientific concepts effectively in written and oral form
- Use laboratory techniques and equipment to perform biochemical experiments
- Work effectively as a member of a team to complete laboratory experiments

General Transferable Skills:

- Develop time-management and organizational skills to balance coursework and extracurricular activities
- Develop computer skills to analyze and visualize biochemical data
- Develop problem-solving and decision-making skills that are transferable to a wide range of careers in biomedical sciences.

Course Topics and Objectives for Each Topic:

1. Introduction to Biochemistry:

- Define biochemistry and describe its applications in biomedical sciences.
- Explain the different levels of biological organization, from molecules to cells to organisms.

2. Chemical Foundations of Biochemistry:

- Describe the basic principles of chemistry, including atomic structure, chemical bonding, and thermodynamics.
- Explain the properties of water and their significance in biological systems.

3. Proteins:

- Describe the structure and function of proteins, including amino acid structure, protein folding, and protein-protein interactions.
- Explain the role of proteins in enzyme catalysis and regulation.

4. Enzymes:

- Explain the basic principles of enzyme kinetics and catalysis.
- Describe the different factors that affect enzyme activity, including pH, temperature, and substrate concentration.

5. Carbohydrates:

- Describe the structure and function of carbohydrates, including monosaccharides, disaccharides, and polysaccharides.

- Explain the role of carbohydrates in energy storage and as structural components in the cell.

6. Lipids:

- Describe the structure and function of lipids, including fatty acids, triglycerides, phospholipids, and cholesterol.
- Explain the role of lipids in energy storage, membrane structure, and signaling.

7. Nucleic Acids:

- Describe the structure and function of nucleic acids, including DNA and RNA.
- Explain the role of nucleic acids in gene expression and protein synthesis.

8. DNA Replication:

- Explain the basic principles of DNA replication, including the roles of DNA polymerase, primase, and helicase.
- Describe the different mechanisms of DNA damage and repair.

9. Transcription:

- Explain the basic principles of transcription, including the roles of RNA polymerase and transcription factors.
- Describe the different types of RNA, including messenger RNA, transfer RNA, and ribosomal RNA.

10. Translation:

- Explain the basic principles of translation, including the roles of ribosomes and transfer RNA.
- Describe the different stages of translation, including initiation, elongation, and termination.

11. Energy Metabolism:

- Describe the basic principles of energy metabolism, including the major metabolic pathways such as glycolysis, the citric acid cycle, and oxidative phosphorylation.
- Explain the role of coenzymes such as NAD+ and FAD in energy metabolism.

12. Carbohydrate Metabolism:

- Explain the regulation of glucose metabolism, including the role of insulin and glucagon.
- Describe the different disorders of carbohydrate metabolism, such as diabetes mellitus.

13. Lipid Metabolism:

- Explain the regulation of lipid metabolism, including the role of hormones such as insulin and glucagon.
- Describe the different disorders of lipid metabolism, such as hyperlipidemia and atherosclerosis.

14. Amino Acid Metabolism:

- Describe the metabolism of amino acids, including transamination and deamination.
- Explain the role of the urea cycle in nitrogen metabolism.

15. Metabolic Regulation:

- Explain the different mechanisms of metabolic regulation, including feedback inhibition, allosteric regulation, and covalent modification.
- Describe the different signal transduction pathways that regulate metabolism.

23. Structural Biology:

- Explain the principles of structural biology, including X-ray crystallography and nuclear magnetic resonance (NMR) spectroscopy.
- Describe the applications of structural biology in drug design and development.

24. Biophysical Chemistry:

- Describe the principles of biophysical chemistry, including thermodynamics, kinetics, and spectroscopy.
- Explain the applications of biophysical chemistry in the study of biological macromolecules.
- Understand the mechanisms of protein-protein interactions
- Understand the mechanisms of protein-nucleic acid interactions

25. Bioenergetics:

- Explain the principles of bioenergetics, including the free energy change and the Gibbs energy equation.
- Describe the different methods used to measure energy changes in biological systems.

Practical Classes:

1. Amino acid analysis
2. Peptide synthesis and purification
3. Protein expression and purification
4. Protein crystallization
5. X-ray crystallography structure determination
6. Protein stability assays
7. Enzyme activity assays
8. Membrane protein purification and reconstitution
9. Lipid bilayer formation and characterization
10. Carbohydrate analysis
11. Protein-protein interaction assays
12. Molecular modeling of proteins and nucleic acids
13. Virtual screening of small molecules

Objectives for each practical class:

1. Understand the properties of amino acids and how to perform their analysis
2. Understand the principles of peptide synthesis and purification
3. Understand the principles of protein expression and purification
4. Understand the principles of protein crystallization
5. Understand the principles of protein stability assays
6. Understand the principles of enzyme activity assays
7. Understand the principles of membrane protein purification and reconstitution
8. Understand the principles of lipid bilayer formation and characterization
9. Understand the properties of carbohydrates and how to analyze them
10. Understand the principles of protein-protein interaction assays
11. Understand the principles of molecular modeling of proteins and nucleic acids
12. Understand the principles of virtual screening of small molecules

5	Course title: General Forensic Sciences	Course Code: FRSC-101

Overall Description and Aims:

The course is designed to provide students with a comprehensive understanding of the principles and practices of forensic science. The course covers a broad range of topics, including crime scene investigation, forensic toxicology, DNA analysis, and forensic anthropology. The aim of the course is to prepare students for a career in forensic science by providing them with the necessary knowledge, skills, and practical experience.

Intended Learning Outcomes:

Upon completion of the course, students will have gained the following knowledge, skills, and abilities:

Knowledge and Understanding:

- An understanding of the principles and practices of forensic science
- Knowledge of the various techniques and methods used in forensic analysis
- An understanding of the legal and ethical issues surrounding forensic science

Intellectual Skills:

- The ability to analyze and interpret forensic evidence
- The ability to apply scientific methods and techniques to forensic investigations
- The ability to critically evaluate scientific evidence and theories

Professional and Practical Skills:

- The ability to conduct crime scene investigations
- The ability to perform laboratory analyses of forensic evidence
- The ability to present scientific evidence in court

General Transferable Skills:

- The ability to work effectively in a team
- Effective communication and presentation skills
- Time management and organization skills

Course Topics and Objectives:

1. Introduction to Forensic Science - To understand the basic concepts and principles of forensic science
2. Crime Scene Investigation - To learn the methods and techniques used in crime scene investigation.
3. Physical Evidence - To develop an understanding of the analysis of physical evidence, including fingerprints, footwear impressions, and tool marks
4. Trace Evidence - To develop an understanding of the analysis of trace evidence, including hair, fibers, and paint
5. Bloodstain Pattern Analysis - To introduce students to the analysis of bloodstain patterns and the interpretation of the evidence
6. DNA Analysis - To develop an understanding of the techniques used in DNA analysis and its application in forensic analysis
7. Forensic Toxicology - To develop an understanding of the analysis of drugs and poisons in biological samples
8. Fire and Explosion Investigation - To develop an understanding of the investigation of fire and explosion scenes
9. Fingerprint Analysis - Students will learn the techniques used in the analysis of fingerprints, including the use of powders and chemicals to develop latent prints.
10. Forensic Anthropology - To understand the use of skeletal remains in forensic investigations
11. Forensic Pathology - To learn the methods and techniques used to determine the cause of death in forensic investigations
12. Forensic Toxicology - To learn the methods and techniques used to analyze drugs and poisons in forensic investigations
13. Forensic Serology - To learn the methods and techniques used to analyze biological fluids in forensic investigations
14. Forensic DNA Analysis - To learn the methods and techniques used to analyze DNA evidence in forensic investigations
15. Forensic Odontology - To understand the use of dental evidence in forensic investigations
16. Forensic Entomology - To understand the use of insects in forensic investigations
17. Bloodstain Pattern Analysis - To learn the methods and techniques used to analyze bloodstain patterns in forensic investigations
18. Ballistics - To learn the methods and techniques used to analyze firearms and ammunition in forensic investigations
19. Forensic Firearm Examination - To understand the use of firearms evidence in forensic investigations
20. Questioned Documents - To learn the methods and techniques used to analyze documents in forensic investigations

21. Digital Forensics - To understand the methods and techniques used to analyze digital evidence in forensic investigations
22. Forensic Accounting - To understand the use of financial analysis in forensic investigations
23. Forensic Linguistics - To learn the methods and techniques used to analyze language as a form of evidence in forensic investigations
24. Forensic Entomotoxicology - To understand the use of insects and toxins in forensic investigations
25. Forensic Art - To learn the methods and techniques used to create and analyze facial reconstructions and other forms of forensic art
26. Forensic Document Examination - To understand the principles and techniques used to analyze handwriting, typewriting and other forms of document evidence
27. Forensic Photography - To learn the methods and techniques used to capture and analyze photographic evidence in forensic investigations
28. Expert Witness Testimony - To understand the role of the expert witness in a court of law and to develop the skills necessary to present expert testimony
29. Crime Scene Reconstruction - To learn the methods and techniques used to reconstruct a crime scene and to interpret physical evidence in the context of a crime

Practical Classes:

Practical classes will provide students with hands-on experience in a range of forensic techniques, such as crime scene investigation, DNA analysis, fingerprinting, and bloodstain pattern analysis. Students will work in small groups and learn to use a variety of laboratory equipment and techniques to analyze and interpret forensic evidence.

1. Crime Scene Investigation - Students will learn the techniques and methods used in the investigation of a crime scene, including the collection and preservation of physical evidence.
2. Fingerprint Analysis - Students will learn the techniques used in the analysis of fingerprints, including the use of powders and chemicals to develop latent prints.
3. Bloodstain Pattern Analysis - Students will learn the techniques used in the analysis of bloodstain patterns, including the use of luminol and other reagents to detect blood.

4. DNA Analysis - Students will learn the techniques used in DNA analysis, including the extraction, quantification, and amplification of DNA samples.
5. Forensic Toxicology - Students will learn the techniques used in the analysis of drugs and poisons in biological samples, including urine and blood.
6. Trace Evidence Analysis - Students will learn the techniques used in the analysis of trace evidence, including hair, fibers, and paint.
7. Forensic Anthropology - Students will learn the techniques used in the analysis of human remains, including skeletal analysis and the determination of age and sex.
8. Digital Forensics - Students will learn the techniques used in digital forensics, including the acquisition and analysis of computer systems and mobile devices.
9. Forensic Document Examination - Students will learn the techniques used in the analysis of questioned documents, including handwriting and signature analysis.
10. Fire and Explosion Investigation - Students will learn the techniques used in the investigation of fire and explosion scenes, including the collection and analysis of debris samples.
11. Firearms and Toolmark Analysis - Students will learn the techniques used in the analysis of firearms and toolmarks, including the use of microscopy and comparison analysis.
12. Forensic Entomology - Students will learn the techniques used in the analysis of insects in forensic investigation, including the determination of time of death.

6	Course title: General Microbiology	Course Code: MLSC-102

Overall description and Aims:

The course is designed to introduce students to the fundamentals of microbiology. The course covers the structure, physiology, genetics, and diversity of microorganisms, as well as their roles in health, disease, and the environment.

Intended Learning Outcomes:

Knowledge and Understanding:

1. Understand the characteristics and classification of microorganisms
2. Understand the principles of microbial growth and metabolism
3. Understand the basic genetics and molecular biology of microorganisms
4. Understand the roles of microorganisms in health, disease, and the environment
5. Understand the principles of microbiological techniques and their applications

Intellectual Skills:

1. Analyze and interpret data from microbiological experiments
2. Evaluate scientific evidence and arguments related to microbiology
3. Synthesize and communicate complex microbiological concepts and ideas
4. Apply critical thinking and problem-solving skills to microbiological challenges

Professional and Practical Skills:

1. Conduct aseptic techniques and handle microorganisms safely
2. Prepare and sterilize microbiological media and reagents
3. Isolate, cultivate, and identify microorganisms from different sources
4. Perform basic biochemical and physiological tests on microorganisms
5. Use molecular biology techniques to manipulate and analyze microbial DNA and RNA

General Transferable Skills:

1. Work effectively in a team and communicate with peers and supervisors
2. Manage time and prioritize tasks in a laboratory setting
3. Maintain accurate records and document laboratory procedures and findings
4. Use digital and online resources for scientific research and communication

5. Apply ethical principles and standards in microbiological research and practice

Course Topics:

1. Introduction to Microbiology
2. Microbial Cell Structure and Function
3. Microbial Nutrition and Growth
4. Microbial Metabolism and Energy Production
5. Microbial Genetics and DNA Replication
6. Microbial Transcription and Translation
7. Microbial Recombination and Gene Transfer
8. Microbial Diversity and Classification
9. Bacteria: Morphology, Physiology, and Pathogenesis
10. Bacteria: Ecology, Evolution, and Biotechnology
11. Viruses: Structure, Replication, and Pathogenesis
12. Viruses: Epidemiology, Control, and Biotechnology
13. Fungi: Morphology, Physiology, and Ecology
14. Fungi: Pathogenesis, Epidemiology, and Biotechnology
15. Protozoa: Morphology, Physiology, and Ecology
16. Protozoa: Pathogenesis, Epidemiology, and Biotechnology
17. Microbial Interactions and Communities
18. Microbial Biotechnology and Applications
19. Microbial Control and Antimicrobial Agents
20. Immunology: Innate and Adaptive Immunity
21. Immunology: Antibodies and Antigens
22. Immunology: Cell-Mediated Immunity and Vaccines
23. Microbial Diseases of Humans and Animals
24. Microbiology of Food and Water Safety

16 Practical Classes:

1. Aseptic techniques and microbial culture handling
2. Preparation and sterilization of microbiological media and reagents
3. Isolation and cultivation of bacteria from environmental samples
4. Identification of bacterial species based on morphology and biochemical tests.

6. Characterization of bacterial metabolism and growth kinetics
7. Antibiotic susceptibility testing and determination of minimum inhibitory concentration (MIC)
8. Transformation of bacteria with plasmids and gene expression analysis

9. Isolation and identification of fungi from environmental samples
10. Identification of fungi based on morphology and biochemical tests
11. Isolation and identification of protozoa from environmental samples
12. Immunological techniques: Enzyme-linked immunosorbent assay (ELISA) and Western To demonstrate biodegradation of hydrocarbons and heavy metals by microorganisms

7	Course title: Hematology and Immunology	Course Code: MLSC-103

Overall Description and Aims:

The Hematology and Immunology in Biomedical course is designed to provide students with a comprehensive understanding of the fundamental concepts and principles of hematology and immunology. The course aims to develop the students' knowledge and understanding of the fundamental processes involved in blood cell formation, function, and pathology, as well as the key concepts and principles of immune system function and dysfunction. Overall the course will provide a comprehensive understanding of the structure and function of blood cells, blood cell morphology, hematopoiesis, hemostasis, , immune system function, and immunopathology as well as the pathogenesis, diagnosis, and treatment of various hematological disorders. The course will also cover the principles of blood transfusion and the management of hemophilia. Upon completion of the course, students will have a strong foundation in hematology, which will be beneficial for those who wish to pursue careers in fields such as laboratory science, and research.

Intended Learning Outcomes of Course:

Upon completion of this course, students will be able to:

- Demonstrate a comprehensive understanding of the fundamental principles and concepts of hematology and immunology.
- Analyze and interpret laboratory results related to hematology and immunology.
- Develop effective strategies for the diagnosis and treatment of hematologic and immunologic disorders.
- Communicate effectively and professionally with colleagues and patients regarding hematology and immunology issues.

Knowledge and Understanding:

Students will develop an in-depth knowledge and understanding of the following areas:

- Blood cell formation and function
- Hemostasis and thrombosis

- Immune system components and their functions
- Hypersensitivity reactions and autoimmune disorders
- Hematologic and immunologic disorders and their treatments

Intellectual Skills:

Students will develop the following intellectual skills:

- Analytical and critical thinking
- Problem-solving skills
- Ability to evaluate evidence and make sound judgments
- Independent learning and research skills

Professional and Practical Skills:

- Analyze and interpret laboratory results of hematological and immunological tests
- Evaluate the clinical significance of laboratory results
- Effective communication and presentation skills
- Teamwork and collaboration skills
- Practical skills in laboratory diagnosis of hematological and immunological disorders.

General Transferable Skills:

- Time management and organization skills
- Adaptability and flexibility
- Manage time and prioritize tasks
-

Course Topics and Objectives:

1. Introduction to Hematology and Immunology:

- Understand the fundamental principles of hematopoiesis and immune cell development.
- Understand the components and functions of blood.
- Understand the different types of immunity and their functions.
- Understand the basic concepts of immune responses.

2. Blood Cells and Blood Count:

- Understand the formation, function, and life cycle of erythrocytes, leukocytes, and platelets.
- Identify the morphology and normal range of blood cells.
- Understand the clinical significance of abnormal blood counts.
- Interpret blood count results and develop appropriate treatment plans.

3. Hematopoietic System:

- Understand the anatomy and physiology of the hematopoietic system.
- Understand the process of hematopoietic stem cell differentiation.
- Understand the role of cytokines in hematopoiesis.
- Understand the different types of hematopoietic disorders and their treatments.

4. Hemoglobin and Hemostasis:

- Understand the structure and function of hemoglobin.
- Understand the mechanisms of blood coagulation and fibrinolysis.
- Understand the causes and consequences of bleeding disorders.
- Understand the causes and consequences of thrombotic disorders.

5. Blood Transfusion:

- Understand the principles and indications of blood transfusion.
- Understand the different types of blood products and their uses.
- Develop skills in performing and interpreting laboratory tests for hematological and immunological diseases
- Develop skills in blood grouping, cross-matching, and compatibility testing
- Understand the principles and techniques of blood transfusion and hematopoietic stem cell transplantation
- Understand the risks and complications of blood transfusion.
- Understand the measures to prevent and manage blood transfusion reactions.

6. Immunology Basics:

- Understand the basic concepts of immune responses.
- Understand the components of the immune system.
- Understand the functions of the innate and adaptive immune systems.
- Understand the antigen-antibody reaction.

7. Innate Immune System:

- Understand the structure and functions of the innate immune system.
- Understand the different types of innate immune cells and their functions.
- Understand the mechanisms of innate immune responses.
- Understand the role of inflammation in innate immunity.

8. Adaptive Immune System:

- Understand the structure and functions of the adaptive immune system.
- Understand the different types of adaptive immune cells and their functions.
- Understand the mechanisms of adaptive immune responses.
- Understand the concept of immunological memory.

9. Antigen Presentation and Processing:

- Understand the process of antigen presentation and processing.
- Understand the different types of antigen-presenting cells and their functions.
- Understand the mechanisms of antigen processing and presentation.
- Understand the role of MHC molecules in antigen presentation.

10. T-Cell Mediated Immunity:

- Understand the process of T-cell activation and differentiation.
- Understand the different types of T-cells and their functions.
- Understand the mechanisms of T-cell mediated immune responses.
- Understand the role of cytokines in T-cell mediated immunity.

11. B-Cell Mediated Immunity:

- Understand the process of B-cell activation and differentiation.
- Understand the different types of B-cells and their functions.
- Understand the mechanisms of B-cell mediated immune responses.
- Understand the concept of antibody diversity.

12. Antibodies:

- Understand the structure and function of antibodies.
- Understand the different types of antibodies and their functions.
- Understand the mechanisms of antibody-mediated immunity.
- Understand the role of antibodies in vaccine-mediated immunity.

13. Immune System Disorders:

- Understand the different types of immune system disorders.
- Understand the causes and consequences of immune deficiency disorders.
- Understand the causes and consequences of hypersensitivity reactions.

14. Immunodeficiency Diseases and Cancer Immunology:

- Understand the principles and techniques of cancer immunology
- Learn about the mechanisms of immune evasion and immune-based therapies for cancer

15. Immunotherapy:

- Understand the principles and applications of immunotherapy.
- Understand the different types of immunotherapy and their uses.
- Understand the mechanisms of action of immunotherapy.
- Understand the risks and benefits of immunotherapy.

16. Immune Responses and Vaccines:
    - To understand the mechanisms of immune responses and the development and use of vaccines.

17. Laboratory Diagnosis of Hematological and Immunological Diseases:

- Understand the principles and methods of laboratory diagnosis of hematological and immunological diseases
- Develop skills in performing and interpreting laboratory tests for hematological and immunological diseases

18. Immunological Techniques:

- Understand the different techniques used in immunology research.
- Understand the principles and applications of flow cytometry.
- Understand the principles and applications of ELISA.
- Understand the principles and applications of Western blotting.

19. Hematological Techniques:

- Understand the different techniques used in hematology research.
- Understand the principles and applications of blood cell counting.
- Understand the principles and applications of coagulation assays.
- Understand the principles and applications of bone marrow aspiration.

Objectives for Practical Classes:

1. Blood Cell Counting:

- Perform a complete blood cell count.
- Identify and differentiate blood cells under a microscope.
- Interpret blood cell count results.

2. Blood Smear Preparation and Staining:

- Prepare and stain a blood smear.
- Identify and differentiate blood cells under a microscope.
- Recognize abnormal blood cell morphology.

3. Coagulation Assays:

- Perform coagulation assays.
- Interpret coagulation assay results.
- Identify abnormal coagulation patterns.

4. Blood Grouping and Crossmatching

- Determine ABO and Rh blood groups and perform a crossmatch to ensure compatibility for blood transfusion

5. Flow Cytometry:

- Perform flow cytometry analysis.
- Interpret flow cytometry results.
- Identify different cell populations based on their surface markers.

6. ELISA:

- Perform an ELISA assay.
- Interpret ELISA results.
- Quantify the amount of target antigen or antibody.

7. Western Blotting:

- Perform a Western blotting assay.
- Interpret Western blotting results.
- Identify target proteins based on their molecular weight.

8	Course title: Anatomy and Physiology	Course Code: ANAT-101

Overall description and Aims:

the course focuses on the structure and function of the human body. This course aims to provide students with a comprehensive understanding of the human body's systems and functions, including their interrelationships and regulation. Students will learn about the major anatomical structures of the human body, including the skeletal, muscular, nervous, respiratory, digestive, cardiovascular, and endocrine systems. In addition, they will also study the physiological processes and mechanisms that control and maintain the body's functions.

Intended Learning Outcomes of Course:

The course's intended learning outcomes can be divided into four categories, including knowledge and understanding, intellectual skills, professional and practical skills, and general transferable skills.

Knowledge and Understanding:

1. Understand the fundamental concepts of anatomy and physiology.
2. Identify the different anatomical structures and their functions.
3. Describe the physiology and regulation of different systems and organs in the human body.
4. Understand the importance of homeostasis in the human body.

Intellectual Skills:

1. Develop analytical and critical thinking skills.
2. Evaluate and interpret scientific data and research findings.
3. Apply scientific principles to real-world scenarios.
4. Develop problem-solving skills.

Professional and Practical Skills:

1. Demonstrate effective communication skills in scientific and professional contexts.
2. Develop teamwork and collaboration skills.
3. Develop laboratory skills and techniques.

4. Understand ethical and legal considerations in the biomedical field.

General Transferable Skills:

1. Develop research and study skills.
2. Develop time management and organizational skills.
3. Develop independent learning skills.
4. Develop lifelong learning skills.

28 Course Topics and Objectives for Each Topic:

1. Introduction to Anatomy and Physiology:

- Understand the basic concepts and terminologies of anatomy and physiology.

2. Levels of Organization:

- Identify the different levels of organization in the human body.

3. Homeostasis:

- Understand the concept of homeostasis and its importance in the human body.

4. Cell Biology:

- Understand the structure and function of cells in the human body.

5. Tissues:

- Identify the different types of tissues in the human body.

6. Integumentary System:

- Understand the anatomy and physiology of the integumentary system.

7. Skeletal System:

- Identify the different bones and joints in the human body.
- Understand the structure and function of the skeletal system.

8. Muscular System:

- Identify the different types of muscles in the human body.

- Understand the structure and function of the muscular system.

9. Nervous System:

- Identify the different parts of the nervous system.
- Understand the structure and function of the nervous system.

10. Endocrine System:

- Identify the different glands and hormones in the human body.
- Understand the structure and function of the endocrine system.

11. Cardiovascular System:

- Identify the different parts of the cardiovascular system.
- Understand the structure and function of the cardiovascular system.

12. Lymphatic System:

- Identify the different parts of the lymphatic system.
- Understand the structure and function of the lymphatic system.

13. Respiratory System:

- Identify the different parts of the respiratory system.
- Understand the structure and function of the respiratory system.

14. Digestive System:

- Identify the different parts of the digestive system.
- Understand the structure and function of the digestive system.

15. Urinary System:

- Identify the different parts of the urinary system.
- Understand the structure and function of the urinary system.

16. Reproductive System:

- Identify the different parts of the male and female reproductive systems.
- Understand the structure and function of the reproductive system.

17. Development and Inheritance:

- Understand the processes of development and inheritance, including embryonic development, fetal development, and genetic inheritance.

18. Immune System:

- Identify the different parts of the immune system.
- Understand the structure and function of the immune system.

19. Sensory Systems:

- Identify the different sensory systems in the human body, including vision, hearing, and touch.
- Understand the structure and function of the sensory systems.

20. Musculoskeletal System:

- Understand the interrelationship between the muscular and skeletal systems.
- Understand the biomechanics of movement.

22. Body Fluids and Electrolytes:

- Understand the balance of body fluids and electrolytes in the human body.

23. Acid-Base Balance:

- Understand the regulation of acid-base balance in the human body.

24. Exercise and Human Performance:

- Understand the physiological responses to exercise and the effects of physical activity on the human body.

25. Aging and the Human Body:

- Understand the physiological changes that occur with aging.

27. Clinical Applications of Anatomy and Physiology:

- Understand the relevance of anatomy and physiology in clinical settings.

Practical Class:

1. Introduction to Laboratory Techniques:

- Understand the basic laboratory techniques used in anatomy and physiology.

2. Histology:

- Identify different types of tissues using histological techniques.

3. Skeletal System:

- Identify different bones and joints in the human body.

4. Muscular System:

- Identify different muscles in the human body.

5. Nervous System:

- Identify different parts of the nervous system.

6. Endocrine System:

- Identify different glands and hormones in the human body.

7. Cardiovascular System:

- Identify different parts of the cardiovascular system.

8. Respiratory System:

- Identify different parts of the respiratory system.

9. Digestive System:

- Identify different parts of the digestive system.

10. Urinary System:

- Identify different parts of the urinary system.

11. Reproductive System:

- Identify different parts of the male and female reproductive systems.

12. Development and Inheritance:

- Understand embryonic and fetal development.

13. Immune System:

- Identify different parts of the immune system.

14. Sensory Systems:

- Understand the structure and function of sensory systems.

15. Musculoskeletal System:

- Understand the biomechanics of movement.

16. Exercise Physiology:

- Understand the physiological responses to exercise.

9	Course title: Scientific Skills and Communication	Course Code: BMSC-103

Overall Description and Aims:

The Scientific and Communication Skill undergraduate course is designed for first-year students and aims to develop the fundamental knowledge, skills and competencies required for successful communication in the scientific domain. This course emphasizes the importance of effective communication in scientific research, writing and presenting research findings to diverse audiences, and developing a range of professional and practical skills for a successful career in science.

Intended Learning Outcomes of the Course:

By the end of the course, students will have gained a strong foundation in the following areas:

Knowledge and Understanding:

1. Scientific communication principles and practices
2. Key concepts in scientific research, analysis, and writing
3. The role of communication in research, education and public outreach

Intellectual Skills:

1. Critical thinking and analytical skills
2. Effective scientific writing and reporting
3. Presentation skills for diverse audiences
4. Data analysis and interpretation

Professional and Practical Skills:

1. Project management and teamwork skills
2. Ethical considerations in scientific research and communication
3. Technical skills for scientific research and communication

General Transferable Skills:

1. Time management and organizational skills
2. Creative thinking and problem-solving
3. Adaptability and flexibility

Course Topics and Objectives for Each Topic:

1. Introduction to scientific communication: Overview of course objectives and expectations
2. Key concepts in scientific research: Understanding the scientific method and the research process
3. Research ethics and integrity: Ethical considerations in scientific research and communication
4. Literature review and referencing: Conducting effective literature searches and referencing
5. Writing scientific reports: Principles and practices of effective scientific writing
6. Writing for diverse audiences: Adapting writing styles and formats for different audiences
7. Writing abstracts and introductions: Crafting effective abstracts and introductions for scientific reports
8. Writing methods and results: Communicating methods and results in scientific reports
9. Writing discussion and conclusions: Summarizing findings and drawing conclusions in scientific reports
10. Preparing scientific posters: Design and presentation of scientific posters
11. Oral presentations: Preparation and delivery of oral presentations
12. Data analysis and visualization: Principles and practices of effective data analysis and visualization
13. Research design and planning: Principles and practices of effective research design and planning
14. Teamwork and project management: Effective teamwork and project management in scientific research
15. Time management and organization: Strategies for effective time management and organization in scientific research
16. Effective use of technology: Effective use of technology in scientific research and communication
17. Introduction to statistics: Key concepts in statistical analysis for scientific research
18. Introduction to data analysis software: Introduction to common data analysis software
19. Introduction to data visualization software: Introduction to common data visualization software
20. Data interpretation and reporting: Principles and practices of effective data interpretation and reporting

21. Interpreting and presenting results: Interpreting and presenting research findings in scientific reports
22. Communicating uncertainty: Communicating uncertainty in scientific research and reporting
23. Communicating with non-scientific audiences: Effective communication with non-scientific audiences
24. Communicating with the media: Principles and practices of effective communication with the media
25. Outreach and public engagement: Principles and practices of effective public outreach and engagement

16 Practical Classes and Objectives for Each Practical Class:

1. Effective literature searches: Conducting effective literature searches for scientific research
2. Referencing and citation management: Effective referencing and citation management in scientific writing
3. Writing abstracts and introductions: Practice writing effective abstracts and introductions for scientific reports
4. Writing methods and results: Practice communicating methods and results in scientific reports
5. Writing discussion and conclusions: Practice summarizing findings and drawing conclusions in scientific reports
6. Designing scientific posters: Design and presentation of scientific posters
7. Delivering oral presentations: Preparation and delivery of oral presentations
8. Data analysis using Excel: Basic data analysis using Excel software
9. Data analysis using statistical software: Basic data analysis using statistical software
10. Data visualization using Excel: Basic data visualization using Excel software
11. Data visualization using graphical software: Basic data visualization using graphical software
12. Research project design: Developing and designing a research project
13. Research project management: Managing a research project
14. Scientific writing and reporting: Practice writing a scientific report
15. Scientific presentation practice: Practice delivering a scientific presentation
16. Outreach and engagement practice: Practice engaging with the public and communicating scientific research.