Bachelor of Science in Medical Biochemistry
(B. Sc. Medical Biochemistry)

Four Years
(8 Semesters)

CURRICULUM

POKHARA UNIVERSITY
FACULTY OF SCIENCE AND TECHNOLOGY

2006
AN INTRODUCTION

A. GENERAL

1. Title
The title of the program is Bachelor of Science in Medical Bio-chemistry.

2. Objective
The objective of the B. Sc. Medical Bio-chemistry program is to produce a technical/professional graduates.

3. Course Structure
   - The program follows the credit system. Each course is assigned a certain number of credits depending generally upon its lecture and tutorial hours in a week. In theory subjects, one lecture per week is assigned one credit as a general rule. One credit of practical involves at least three hours practical work per week.
   - The B. Sc. Medical Bio-chemistry course comprises the total of 144 credit hours spreading over eight semesters.
   - Biochemistry is loosely defined as chemistry of life and draws its background knowledge from chemistry and to some extent from physics and statistics. The course is medical / clinical related to the public health and emphasize and help to the physicians / clinicians / surgeons etc. to disease diagnose. Placing considerable emphasis on this fact, the courses are taken from following distinct components:
     o Biochemistry
     o Chemistry
     o Clinical Biochemistry
     o Bio Physics
     o Biostatistics
     o Analytical Biochemistry
     o Research Methodology
     o Biomolecules
     o Molecular Biology and Biotechnology
     o Anatomy and Physiology
     o Bioinformatics
     o Practical
     o Seminar
     o Project Work
   - Three credit hours of theory is equivalent to 48 hours lecture and one credit hour of practical is equivalent to 45 hours practical is one semester.

Course Coding
4. Each course is identified by initial letter of the course title followed by three digit number and credit hours after decimal i.e. Fundamental Chemistry (FCH 104.3), LAB I (LAB 1.1).

5. Normal and Maximum Duration of Stay in the University
The normal duration for completing the B. Sc. Medical Bio-chemistry course is four years. In exceptional case; however, the student is allowed normal duration plus four years to complete the course. If a student is unable to complete the course within eight years from the time of admission, the University registration is annulled.

6. Academic Schedule
The academic session consists of two semesters per year. Generally the Fall Semester (September - February) starts in September and the Spring Semester (February - August) begins in February, however it may differ slightly in any particular year.

7. Medium of Teaching and Examination
The medium of instruction and examination for B. Sc. Medical Bio-chemistry program will be English.
B. ADMISSION AND EXAMINATION

1. Entry Requirement for New Student
The entry requirement for a new student will be Intermediate in Science (I. Sc.) or Higher Secondary level (10+2, Science Stream) or Proficiency Certificate Level (PCL, Science), or equivalent as recognized by Pokhara University with at least second division. Besides the basic academic requirement, an entrance examination will be held for all applicants.

2. Admission Procedure
A notice inviting application for admission is publicly announced. The application forms and information brochures are provided, on request, after the payment of the prescribed fee.

The concerned college scrutinizes the applications. The eligible candidates are informed to take the entrance test. The date and time for the entrance test is informed to the prospective students by the college. The college may also interview the candidates for final selection for admission.

The candidates, who are given provisional admission under special condition, are required to submit all necessary documents within a month of the beginning of regular classes. Otherwise, the admission will be annulled.

3. Student Evaluation
The student’s academic performance during a semester will be evaluated internally (sessional work) and externally (the final examination). The sessional work examination will be evaluated by the teaching Faculty and it will be of 50% weight. The remaining 50% will be the final examination, conducted by University.

In the Practical courses, no final examination will be conducted and the sessional marks shall be awarded on the basis of internal assessment. To pass a particular course, a student must obtain a minimum of D grade in sessional work (average of internal assessments) and the final examination, separately.

4. Attendance Requirement
The students must attend every lecture, tutorial, seminar and practical classes. However, to accommodate for sickness and other contingencies, the attendance requirement shall be a minimum of 80% of the classes in any particular subject, otherwise s/he shall not be allowed to take the final examination in that subject. If a student is continuously absent in the class for more than four weeks without notifying the authorities, his/her name will be removed from the college roll.

5. Course Registration
The academic record of a student shall be maintained in terms of the courses for which s/he registers in any semester, and the grades s/he obtains in those courses. Registration for courses is done at the beginning of each semester. Since registration is a very important procedural part of the credit system, it is absolutely essential that all students present themselves at the school. In case of illness or any exceptional circumstance during the registration period, the student must inform the University authority. Registration absencia may be allowed only in rare cases, at the discretion of the authorized person. However, the student's nominee cannot register for courses and will only be allowed to complete other formalities. Generally in a particular semester or year only those courses would be offered for registration which are mentioned in the syllabus, however their sequence may be interchanged if necessary.

6. Repeating a Course
Since passing of all courses individually is a degree requirement, the student must retake the failing course when offered and must successfully complete the course. Retaking a course in which a student has earned a D grade is optional. Student can retake a course when one receives GPA less than 2.0. The grade earned on the retake will be substituted for the grade earned previously.

7. Transfer of Credit Hours
A maximum up to 25% of the total credit hours of course completed in an equivalent program of a recognized institution may be transferred / waived for credit on the recommendation of the head of the faculty. For transfer of credit, a student must have received a grade of B or better in respective course. Courses taken earlier than five years from the time of transfer may not be accepted for transfer of credit. However, a student transferring from one program to another program of Pokhara University may receive a credit transfer of all the compatible courses completed with at least grade C.

The concerned Subject Committee of the University will make an evaluation of the applicant for transfer of credit. The awarding of transferred credit will be based on the applicant’s score in the University, which s/he has attended previously.
8. Final Examination
University conducts final examination at the end of each semester. The procedure of final examination conduction will be as per the examination rules of the University.

9. Unsatisfactory Results
Students may apply for re-totaling or rechecking of their grades as per University rule, upon payment of prescribed fee.

C. GRADING SYSTEM
The grades (marks) awarded to student in a course are based on his/her consolidated performance in seasonal and final examinations. The letter grade in any particular subject is an indication of a student's relative performance in that course. The pattern of grading will be as follows:

<table>
<thead>
<tr>
<th>Letter</th>
<th>Grade</th>
<th>Grade point</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.0</td>
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<td>Excellent</td>
</tr>
<tr>
<td>A-</td>
<td>3.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B+</td>
<td>3.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>3.0</td>
<td></td>
<td>Good</td>
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<tr>
<td>B-</td>
<td>2.7</td>
<td></td>
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</tr>
<tr>
<td>C+</td>
<td>2.3</td>
<td></td>
<td>Satisfactory</td>
</tr>
<tr>
<td>C</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-</td>
<td>1.7</td>
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<td></td>
</tr>
<tr>
<td>D+</td>
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</tr>
<tr>
<td>D</td>
<td>1.0</td>
<td>Minimum requirement</td>
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<tr>
<td>F</td>
<td>0.0</td>
<td>Failing</td>
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</table>

In unusual circumstances, the student may be awarded an incomplete grade of "I". If all the requirements are not completed within the following semester, the grade of "I" will be automatically converted to an "F". A student receiving an "I" grade does not need to register for that subject in the following semester to complete the required works.

The performance of a student in a semester will be evaluated in terms of the semester grade point average (SGPA). The student’s final grade will be calculated on cumulative grade point average (CGPA).

\[ \text{SGPA} = \frac{\text{Total honor points earned in a semester}}{\text{total number of credits registered in a semester}} \]

\[ \text{CGPA} = \frac{\text{Total honor points earned}}{\text{total number of credits completed}} \]

D. DIVISION EQUIVALENCE
In Pokhara University, CGPA 2.0 or more and 3.0 or more are considered as Second and First divisions, respectively.

E. DISMISSAL FROM THE PROGRAM
A student is normally expected to obtain a CGPA of 2.0, the student, whose performance in the past semesters does not show the possibility of maintaining this CGPA, may be advised to leave or dismissed from the program.

F. AWARD OF DEGREE
On completion of all requirements with CGPA of 2.0 or better, the student will be awarded a degree of Bachelor of Science in Medical Bio-chemistry.

G. DEGREE WITH DISTINCTION
To obtain a degree with distinction, a student must obtained CGPA 3.6 or better.

H. DEAN'S LIST
The Dean’s list recognizes outstanding performances of academic excellence by students. To qualify, a student must obtain a CGPA of 3.7 or better.

Note: The provisions of this document are not to be regarded as a binding contract between the University and the students. The University reserves the right to change any provisions or requirements contained in this document at any time, without pre-notification, within the students' term of residence.
## CURRICULUM STRUCTURE
Bachelor of Science in Medical Biochemistry  
(B. Sc. Medical Biochemistry)

### FIRST YEAR
#### FIRST SEMESTER

<table>
<thead>
<tr>
<th>Code</th>
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<th>Credit hours</th>
<th>Pre-requisite course</th>
<th>Core course</th>
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<tbody>
<tr>
<td>ENG 101.3</td>
<td>Professional English</td>
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<tr>
<td>PCH 102.3</td>
<td>Physical Chemistry I</td>
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<tr>
<td>OCH 103.3</td>
<td>Organic Chemistry I</td>
<td>3</td>
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<td>ICH 104.3</td>
<td>Inorganic Chemistry</td>
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<td>FBC 105.3</td>
<td>Fundamental of Biochemistry</td>
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<td>LAB 2.1</td>
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**Total** 19

### SECOND SEMESTER

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<td>Physical Chemistry II</td>
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<td>OCH 107.3</td>
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<td>HAP 108.3</td>
<td>Human Anatomy and Physiology I</td>
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<td>BPS 109.3</td>
<td>Biophysics</td>
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<td>CBC 110.3</td>
<td>Clinical Biochemistry I (Instrumentation)</td>
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<td>LAB 5.1</td>
<td>Physical Chemistry II</td>
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<td>LAB 6.1</td>
<td>Organic Chemistry II</td>
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<td>LAB 7.1</td>
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<td>Clinical Biochemistry I (Instrumentation)</td>
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**Total** 19
SECOND YEAR

THIRD SEMESTER

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<tr>
<td>BMO 201.3</td>
<td>Bio-molecules I</td>
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<td>MET 202.3</td>
<td>Metabolism I</td>
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<tr>
<td>HAP 203.3</td>
<td>Human Anatomy and Physiology II</td>
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<td>PTO 204.3</td>
<td>Pharmacology and Toxicology</td>
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<td>MBG 205.3</td>
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<td>Human Anatomy and Physiology II</td>
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<td>Microbiology I: General</td>
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Total 20

FOURTH SEMESTER

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<td>BMO206.3</td>
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<td>MET 207.3</td>
<td>Metabolism II</td>
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<td>ENZ 208.3</td>
<td>Enzymology</td>
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<td>BMO 209.3</td>
<td>Bioenergetics</td>
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<td>MBP 210.3</td>
<td>Microbiology II: Parasitology</td>
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<td>LAB 14.1</td>
<td>Bio-molecules II</td>
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<td>LAB 15.1</td>
<td>Metabolism II</td>
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<td>LAB 16.1</td>
<td>Enzymology</td>
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<td>LAB 17.1</td>
<td>Microbiology II: Parasitology</td>
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Total 19
### THIRD YEAR

#### FIFTH SEMESTER

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<td>MBI 301.3</td>
<td>Molecular Biology</td>
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<td>BTE 302.3</td>
<td>Biotechnology</td>
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<td>NBC 303.3</td>
<td>Nutritional Biochemistry</td>
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<td>CBC 304.3</td>
<td>Clinical Biochemistry II</td>
<td>3</td>
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<td>MBB 305.3</td>
<td>Microbiology III: Bacteriology</td>
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<td>LAB 18.1</td>
<td>Molecular Biology</td>
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<td>LAB 19.1</td>
<td>Biotechnology</td>
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<td>LAB 20.1</td>
<td>Nutritional Biochemistry</td>
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<td>LAB 21.1</td>
<td>Clinical Biochemistry II</td>
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<td>Microbiology III: Bacteriology</td>
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#### SIXTH SEMESTER

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<tbody>
<tr>
<td>CBC 306.3</td>
<td>Clinical Biochemistry III</td>
<td>3</td>
<td>Lab Based</td>
<td>Tutorial class</td>
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<td>EPI 307.3</td>
<td>Epidemiology</td>
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<tr>
<td>CBC 308.3</td>
<td>Clinical Biochemistry IV (Analytical)</td>
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<td>Lab Based</td>
<td>Tutorial class</td>
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<td>RME 309.3</td>
<td>Research Methodology</td>
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<td>MBI 310.3</td>
<td>Microbiology IV: Immunology</td>
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<td>LAB 23.1</td>
<td>Epidemiology</td>
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<td>LAB 24.1</td>
<td>Clinical Biochemistry IV (Analytical)</td>
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<td>LAB 25.1</td>
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## FOURTH YEAR

### SEVENTH SEMESTER

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<tbody>
<tr>
<td>CBC 401.3</td>
<td>Clinical Biochemistry V (Diagnostic)</td>
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<td>Lab Based</td>
<td>Tutorial class</td>
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<td>BDM 402.3</td>
<td>Biostatistics and Data Management</td>
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<td>BIN 403.3</td>
<td>Bio-informatics</td>
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<tr>
<td>CBC 404.3</td>
<td>Clinical Biochemistry VI (Management of Lab)</td>
<td>3</td>
<td>Lab Based</td>
<td>Tutorial class</td>
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<td>LAB 26.1</td>
<td>Biostatistics and Data Management</td>
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<td>LAB 27.1</td>
<td>Bio-informatics</td>
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<td>LAB 28.1</td>
<td>Clinical Biochemistry VI (Management of Lab)</td>
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<tr>
<td>SEM 405.1</td>
<td>Seminar I</td>
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**Total** 16

### EIGHTH SEMESTER

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<tbody>
<tr>
<td>DIS 406.6</td>
<td>Thesis</td>
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<td>INT 407.6</td>
<td>Hospital Internship</td>
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<td>SEM 408.1</td>
<td>Seminar II</td>
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**Total** 13
ENG 101.3 (Credit hours 3)

Professional English
B. Sc. Medical Biochemistry, First Year, First Semester

Course Objectives:
Upon successful completion of the course, students will be able to:
- Use tense, time and aspect, communicate on different professional topics.
- Identify sentences (clause) and its types and transformation of sentences and develop reading skills, note making and summarizing from different passages.
- Prepare short memoranda; write business letters, job application, seminar papers, and proposal writing.

Course Contents:

Unit I: Review of Written English: 8 hours
- Sentence structure (identification of sentences or its types and transformation of sentences).
- Clauses.

Unit II: Oral Communication, Note Taking and Summarizing: 15 hours
- Prepositions and noun phrases (noun, adjective and adverbs) their use, verbal phrases,
- Type of English (variety/levels of English).
- Professional writing and talk (Scope of Medical Biochemistry, Role of Biochemistry in Medicine).
- Impact of satellite communication (urban development, drug use problems, role of Biochemists in disease investigation).

Unit III: Technical Writing Skill: 15 hours
- Preparation of short memoranda (importance - formats), health messages, business letters (importance-purposes).
- Paragraph writing (descriptive/narrative, argumentative, compare and contrast etc.).
- Seminar papers writing (conduction of seminar, preparation of circular presenting seminar paper).
- Proposal writing, Report writing, (importance, type, formats), preparation of reports (importance, types, formats).

Unit IV: Reading Skill: 10 hours
- Comprehension questions and exercises from prescribed passages.
- Discovery of DNA.
- Non-communicable diseases.
- People and environment healthy life styles.
- Different biochemical report and article from the journal.
- Outlining or note taking, precise writing.

References:


5. A Hand Book of Pronunciation of English Words (with 90 minutes audiocassette).

6. Communication skills in English.

PCH 102.3 (Credit hours 3)

Physical Chemistry I
B.Sc. Medical Biochemistry, First Year, First Semester

Course Objectives:
Upon completion of the course students shall be able to understand fundamental principles of physical chemistry.

Course Contents:

Unit I: Gaseous State: 8 hours
Distribution of molecular velocities, Boltzmann equation, Types of average velocities, Derivation of the equation of state of an ideal gas, Critical temperature and pressure, Vander Walls equation, Departure from ideal gas laws.

Unit II: Colloids: 8 hours
Sols and their preparation, properties, Electrical properties of sols, Gels, Determination of molecular weight by osmometry and viscosity.

Unit III: Conductance: 8 hours

Unit IV: Kinetics: 10 hours
Rate of reaction, Experimental measurement of reaction rates, Order and Molecularity, Rate equation for zero, first, second and third order reactions. Opposing, Consecutive and Parallel reaction, Energy of activation, Collision theory of uni-molecular and bimolecular reactions, Transition states theory, Chain reactions, Catalysis.

Unit V: Thermodynamics: 14 hours
Entropy, Second law of thermodynamics, Entropy change in ideal gases, Entropy of mixing, Entropy change in physical and chemical transformations, Free energy, Calculation of free energy change, Criteria of equilibrium, Classius – Claperyon equation, Chemical potential, Third law of thermodynamics.

References:
3. B.S., Bahl, Essentials of Physical Chemistry.
OCH 103.3 (Credit hours 3)

Organic Chemistry I
B.Sc. Medical Biochemistry, First Year, First Semester

Course Objectives:
Upon successful completion of the course, students will be able to understand an introductory course in the principles of organic chemistry, with application to the health sciences.

Course Contents:
Unit I: Reaction Mechanism and Kinetics: 5 hours
Homolytic and heterolytic fission of covalent bonds, Functional groups, Nucleophiles and Electrophiles, Organic acids and bases, Types of organic reactions, Organic reaction mechanism, Energetic of reaction, Kinetic and non kinetic methods of determining reaction mechanism.

Unit II: Reactive Intermediates: 4 hours
Introductory treatment of structure, Generation and reactions of organic intermediates such as carbonation, carbanion, free radical, carbenes, nitrene and benzene.

Unit III: Stereochemistry: 7 hours

Unit IV: Conformational Analysis: 5 hours
Open chain and cyclic compounds, Baeyer strain theory, Heats of combustion and relative stabilities of cycloalkanes, Orbital picture of angle strain, Conformations and factor affecting stability of conformations, Conformations of cycloalkanes, Equatorial and axial bonds, Stereochemistry of cyclic compounds: cis and trans isomers, Stereochemistry of cyclic compounds: conformational analysis.

Unit V: Alkane: 6 hours
Preparation, Grignard reagent, Coupling of alkyl halide with organometallic compounds, Mechanism and orientation of halogenation, Relative reactivity of alkanes towards halogenation, Ease of abstraction of hydrogen atom, Stability of free radicals, Transition state for halogenation, Pyrolysis.

Unit VI: Alcohols and Ethers: 8 hours

Unit VII: Alkyl Halide 5 hours
Preparation, Nucleophilic aliphatic substitution, Rate of reaction, SN2 reaction (mechanism, kinetics, stereochemistry and reactivity), SN1reaction (mechanism, kinetics, stereochemistry, and reactivity).
Unit VIII: Alkenes: 8 hours
Structure of ethylene, Hybridization, Physical Properties, Industrial source, Preparation, Dehydrohalogenation and its mechanism, The E2 mechanism, E2 reaction (orientation and reactivity), E1 reaction (mechanism and orientation) Dehydration of alcohols, Reaction of alkenes, Reactions at carbon-carbon double bond, Hydrogenation, Addition of hydrogen halide, Markounikoff's rule, Addition of hydrogen bromide, Peroxide effect, Addition of hydrogen halide, Markounikoff's rule, Addition of hydrogen bromide, Peroxide effect, Addition of Sulphuric acid, Addition of water, Electrophilic addition (mechanism, orientation and reactivity), Addition of halogens and its mechanism, Halohydrin formation, Oxymercuration demercuration, Hydroboration reaction (mechanism and orientation), Mechanism of free radical addition, Orientation of free radical addition, Hydroxylation, Ozonolysis.

References:
ICH 104.3 (Credit hours 3)

Inorganic Chemistry
B.Sc. Medical Biochemistry, First Year, First Semester

Course Objectives:
Upon completion of the course, students shall be able to understand an introductory course in the chemistry of the elements and bonding theory.

Course Contents:
Unit I: Chemical Bonding: 4 hours
Types of bonds, Ionic bonds, Covalent bonds, oxidation number, Coordinate bonds. Double and Triple bonds, Metallic bonds and Metallic structures, Melting points, Conductivity, Solubility, Speed of reactions.

Unit II: The Ionic Bond: 4 hours

Unit III: The Covalent Bond: 5 hours
The Lewis theory: the octet rule, Exceptions to the octet rule, Sidgwick-Powell theory, VSEPR theory: Effect of lone pair, Effect of electro negativity, Isoelectronic principle, some examples using the VSEPR theory (BF3, BF4-, NH3, H2O, PCl5, CIF3, I3-, SF6, IF7), Valence bond theory, hybridization, Extent of d-orbital participation in molecular bonding, sigma and pi bonds, Molecular orbital method, LCAO method (s-s, s-p, p-p, p-d and d-d combination of orbitals). Nonbonding combination of orbitals, Molecular orbital treatment of homonuclear diatomic molecules (H2, He2, N2, O2, H2+, O2- ion) and heteronuclear diatomic molecules (NO, CO and HCl).

Unit IV: Metallic Bond: 4 hours

Unit V: The s-Block Elements: 8 hours
Electronic configuration, Size of atoms and ions, Density, Ionization energy, Electro negativity and bond type, Born-Haber cycle: energy changes in the formation of ionic compounds, Hardness and cohesive energy, Melting and boiling points, Flame colors and spectra, Color of compounds, Chemical properties: Reaction with water, air and dinitrogen, Organic and organometallic compounds, Complexes, Crowns and crypts, Biological importance.

Unit VI: The p-Block Elements: 8 hours
General introduction and uses, Oxidation states and types of bond, (+III) – (+I) Oxidation state, (+I) oxidation state, The inert pair effect. Melting point, Boiling point and structures, Size of atoms and ions, Electropositive character, Ionization energy.
Unit VII: The d-Block Elements: 8 hours
Metallic character, Variable oxidation state, Stability of the various oxidation states, Complexes, Size of atoms and ions, Density, Melting energy, Color: polarization, Incompletely filled d or f shell, Magnetic properties measurement of magnetic moments, Catalytic properties, Nonstoichiometry, Abundance, Differences between the first and other two rows: Metal - metal bonding and cluster compounds, Stability of oxidations states, Complexes, Sizes, Magnetism.

Unit IX: Coordination Chemistry: 7 hours
Double salts and coordination compounds, Werner’s work, Recent methods of studying complexes, Effective atomic numbers, Shapes of d-orbitals, Bonding in transition metal complexes, Valence Bond theory, Ligand field theory, Crystal field theory, Octahedral complexes, Effects of crystal field splitting, Tetragonal distortion of octahedral complexes (Jahn-Teller distortion), Square planar complexes, Tetrahedral complexes, Chelates, Magnetism, Extension of the crystal field theory to allow for some covalency, Molecular orbital picture (π acceptors and π donors), Nomenclature of coordination compounds, Isomerism (Polymerization, Ionization, Hydrate, Linkage, Coordination, Coordination position, Geometrical, Optical).

Reference:
FBC 105.3 (Credit hours 3)

Fundamentals of Biochemistry
B.Sc. Medical Biochemistry, First Year, First Semester

Course Objectives:
Upon completion of the course students shall be able to understand fundamental biochemistry and biological evolution and molecular logic of life of biochemistry.

Course Contents:
Unit I: Introduction: 7 hours
Definition of Medical Biochemistry: History, Scope and Future of Medical Biochemistry, Importance of biochemistry to medicine, Relation of biochemistry with other biological science, Applications of biochemistry in various fields, Nature of organic matter and review of organic reaction mechanisms, Cells- Biochemical functions with Bio-molecules and Bio-elements.

Unit II: Biological Evolution and Development: 7 hours
Biological evolution, pre-biotic molecular evolution and origin of life, molecular selection, chemical evolution and origin of living state, a review of the variety and ecology of the living world, biochemical basis of structure and functional variations in the living beings.

Unit III: The Molecular Logic of Life: 6 hours
Chemical Unity of Diverse Living Organism, Energy Production and Consumption in Metabolism.,

Unit IV: Water: 8 hours
Chemical structure, Ionization of water, Biological function, Properties, Henderson – Habselbalch equation.
Body fluid and its distribution in the body, Factors influencing distribution of body water (fluid), Intake and losses of body water in the body, Regulation of water in body.

Unit V: Acid, Bases, Buffers, pH, Indicator and Solutions: 9 hours
- Importance of physiochemical phenomena in biochemistry, colloidal state, surface tension, viscosity, osmosis and diffusion.
- Definition, Basic concept on Acid, Bases, Buffers, pH, Indicators and Solutions, Types of pH buffer (acetate, phosphate, Tris) and significance and solution (stock, stander, saturated, percentage, molar, normal, partial), Buffering system- buffering against pH changes in the body, with biological system. The fitness of the living organisms in aqueous environment.

Unit VI: Cell: 7 hours
- Prokaryotic and Eukaryotic Cells
- Major structural feature of Eukaryotic cells
- Structure and functions of cell organelles,
- Difference between prokaryotic and Eukaryotic cells.

Unit VI: Sample collection: 4 hours
- Blood sample collection
- Body fluid collection
- Precaution during the sample collection
- Prevention, transportation and storage of samples.
References:
2. Watson, "Molecular biology of cell"
PRACTICAL WORKS

Physical Chemistry I
B.Sc. Medical Biochemistry, First Year, First Semester
1. Determination of dissociation constant of acetic acid using pH meter.
2. Determination of rate constant and half-life of acid catalyzed hydrolysis of methyl acetate.
3. Determination of the concentration of a strong base by conductometric titration with a strong acid and a weak base.
4. Determination of the concentration of the unknown solution by using viscometer.
5. Carrying out the conductometric titration of MOPS (0.1M) vs. and TRIS (0.1M) vs. and finding out the concentration of HCl.
6. Determination of viscosity of methanol, ethanol, n-propanol and n-butanol.
7. Determination of the pKa of MOPS and TRIS buffer by titrating it with HCl.
8. Determination of heat of neutralization of strong acid and strong base titration.
9. Determination of the surface tension of methyl acetate, ethyl alcohol and acetone.

Organic Chemistry I
B.Sc. Medical Biochemistry, First Year, First Semester
1. Detection of functional groups in the given organic compounds.
2. Purification of organic compounds by crystallization methods and to find out its melting point.
3. Purification of organic compounds by crystallization method and to check its purity by mixed melting point method.

Inorganic Chemistry
B.Sc. Medical Biochemistry, First Year, First Semester
1. Identification of two acid radicals present in the given salt mixture by dry and wet ways.
2. Identification of basic radicals present in the given salt by dry and wet ways.
3. Analyzing the salt completely by dry and wet ways.
4. Quantitative estimation of sulphate ion as barium sulphate by gravimetry.
5. Preparation of Prussian blue from iron fillings.
6. Preparation of Cuprous chloride.
7. Preparation of Tetra-ammine copper and sulphate.
8. Preparation of Potassium trioxalato chromate.
10. Preparation of the standard deci normal solution of oxalic acid and standardization of the given potassium permanganate solution by it.
11. Estimation of the amount of Mohr’s salt and ferrous ion present in the given volume of Mohr’s salt solution permanganetometrically in terms of gram equivalent and number of moles.

Fundamental Biochemistry
B.Sc. Medical Biochemistry, First Year, First Semester
1. Apply the safety measures of biochemistry laboratory.
2. Calibration of laboratory pipettes and quality control concept.
3. Preparation of solutions (HCl, NaOH, H₂SO₄) of different concentration (percentage, PPM, normal, molar and molal).
4. Preparation of different buffers (phosphate, acetate, Tris) of different pH values.
5. Determination of pH of different solutions.
6. Titration of acid and bases of different concentration.
B. SC. Medical biochemistry
First Year
Second Semester
PCH 106.3 (Credit hours 3)

Physical Chemistry II
B.Sc. Medical Biochemistry, First Year, Second Semester

Course Objectives:
Upon Completion of the course students will be able to understand topics in theoretical physical chemistry with an introduction to the chemical aspects of statistical mechanics.

Course Contents:

Unit I: Surface Chemistry: 4 hours
- Adsorption, Adsorption of gases by solids, Types of adsorption, Adsorption isotherm, Determination of surface area of adsorbents, Adsorption of solutes by solids.

Unit II: Photochemistry: 4 hours
- Einstein law of photochemical equivalence, Consequences of light absorption by atoms and molecules, Phosphorescence, fluorescence. Use in the biochemistry.

Unit III: Phase Rule: 4 hours
- Gibbs phase rule, One and Two component systems.

Unit IV: Solid State: 8 hours
- Crystalline and amorphous solids and their properties, Lattices and unit cell, Crystal systems, Designation of crystal planes, Diffraction method, Molecular crystals, Van der waal forces, Dispersion bond, Dipole bond, Hydrogen bonded crystals, Bonding and structure, Covalent crystals, Ionic crystals, Reciprocal and Bravais lattice, Miller indices and their calculation in simple crystal, Allotropy and polymorphism, Thermal and magnetic properties: Dulong’s petit law, Debye’s theory, Para magnetism and Diamagnetism.

Unit V: Solid-state Reaction: 4 hours
- Wagner’s theory, oxidation of metals, kinetics of oxide film growth, sintering, photographic process

Unit VI: Superconductivity: 8 hours
- Occurrence, mechanism and critical properties of superconductor. BCS theory of superconductor, High temperature superconductor, Application, Meissner’s effect and effect of magnetic field, Type I, II superconductor.

Unit VII: Electrochemistry: 8 hours
- Standard cells, Standard electrode potentials, Nernst equation, Calculation of single electrode potential and E.M.F., DS and DH, Equilibrium constant, Types of electrode, Chemical cells with and without transference, Concentration cells with and without transference, Junction potential, Over voltage and its measurement, Commercial cells, Use in the biochemistry.

Unit VIII: Statistical Mechanics: 8 hours
- The thermodynamic probability of a system, The most probable distribution, The partition function, Systems of independent particles, The energy of a system, Separation of the partition function, The partition function for translation, The thermodynamic function for translation, rotation, vibration and electronic excitation, Mono atomic gases, Rotation, Vibration, The electronic partition function, Results of statistical calculation, Statistical
calculation of equilibrium constants, Entropy and probability, Bose-Einstein and Fermi - Dirac statistics.

Reference:
Organic Chemistry II
B.Sc. Medical Biochemistry, First Year, Second Semester

Course Objectives:
Upon successful completion of the course, students will be able to understand structure and mechanism of some compound in organic chemistry.

Course Contents:

Unit I: Alkynes: 5 hours

Unit II: Aromaticity: 4 hours
Aliphatic and aromatic compounds, Structure of benzene, Kekule structure, Stability of the benzene ring, Heat of hydrogenation, Carbon-carbon bond lengths in benzene, Orbital picture, Representation of benzene ring, Huckel 4n+2 rule, Polynuclear aromatics, Use in the biochemistry.

Unit III: Electrophilic Aromatic Substitution: 4 hours
Effect of substituent groups, Determination of orientation, Determination of relative reactivity, Classification of substituent groups, Orientation in disubstituted benzenes, Mechanism of nitration, Sulphonation, Halogenation and Friedle crafts reactions, Reactivities and orientations, Theory of orientation, Electron release via resonance, Effect of halogenation on electrophilic aromatic substitution.

Unit IV: Aldehydes and Ketones: 8 hours
Physical properties, Preparation, Preparation of Ketones by friedel craft acylation and use of organo-copper compounds, Reactions: Oxidation, Reduction, Addition of cyanide, Alcohols and derivatives of ammonia, Cannizaro reaction, Addition of Grignard reagents, Products of Grignard synthesis, Limitations of Grignard synthesis, THP group as protecting group, Iodoform test Use in the biochemistry.

Unit V: Carboxylic Acids: 6 hours
Physical properties, Salts of carboxylic acids, Industrial source, Preparation, Grignard and nitrile synthesis, Reactions, Structure of carboxylate ions, Effect of substituents on acidity, Conversion into acid chloride, Esters and amides, Reduction of acids into alcohols, Halogenation of aliphatic acids, Use in the biochemistry.

Unit VI: Amines: 6 hours

Unit VII: Phenols: 7 hours
Structure, Physical properties, Salts of phenols, Preparation, Reactions, Acidity of phenols, Fries rearrangement, Ring substitution, Kolbe's reaction, Riemer tiemann's reaction, Formation of aryl ethers, Use in the biochemistry.
Unit VIII: Carbanions: 8 hours
Acidity of α-hydrogen, Reactions involving carbanions, Base-promoted halogenation of ketones, Acid-catalysed halogenation of ketone, Enolization, Aldol condensation, Dehydration of aldol products, Use of aldol condensation in synthesis, Crossed aldol condensation, Reactions related to the aldol condensation, The Wittig reaction, Claisen condensation, Formation of β-keto esters, Crossed Claisen condensation, Carbanions in organic synthesis, Malonic ester synthesis of carboxylic acid, Acetoacetic ester synthesis of ketones, Decarboxylation of β keto acids and malonic acids, Direct and indirect alkylation of esters and ketones, Synthesis of acids and esters via 2-oxazolines, Organoborate synthesis of acids and ketones, Alkylation of carbonyl compound via enamines

References:
HAP 108.3 (Credit hours 3)

Human Anatomy and Physiology I
B. Sc. Medical Biochemistry, First Year, Second Semester

Course Objectives:
Upon successful completion of the course, students will be able to:
- Understand structures of various organs and system of human body.
- Understand various functions, physiology and infections of organs and systems.
- Describe basic human anatomy and physiology.

Course Contents:
Unit I: Introduction to Applied Human Anatomy and Physiology: 6 hours
- Introduction to applied human anatomy and physiology.
- Anatomical position, terms and terminologies
- Structure, types and function of cells and tissues.
- Body, interstitial and cavity fluid and their importance and functions.

Unit II: Musculoskeletal System (MSS) and Skin: 12 hours
- Introduction of musculo-skeleton system.
- Different parts of involved in skeleton system.
- Gross and microscopic structure of skeleton.
- Function of skeleton.
- Introduction, types and function of joints
- Different parts involved in muscular system.
- Gross and microscopic structure of muscular system
- Function of muscular system.
- Type (transude, exudates), composition and function of body fluids and method of collection of body fluids.
- Structure and function of skin.
- Physiology of musculoskeletal system.
- Method of sample collection: (body cavity fluid, biopsy, autopsy).

Unit III: Respiratory System (RS): 10 hours
- Different organs of the Respiratory System.
- Gross and microscopic structure of different organs of the Respiratory System
- Functions of the different organs of the Respiration.
- Physiology of Respiratory System
- Physiological changes in microbial infection.
- List the common pathological conditions in relation to infection.
- Methods of sample collection from different sites: sputum, bronchial lavage, and bronchial aspiration.

Unit IV: Gastro Intestinal (GI) System: 10 hours
- Gross and microscopic structure of different organs of the Gastro Intestinal system and associated structure.
- Different organs associated with the Gastro Intestinal system: (Salivary glands, Pancreas, Liver and Gall bladder and others).
- Functions of the organs of the Gastro Intestinal system and associated structure.
- Physiology of Gastro Intestinal System.
- List the common pathological conditions in relation to infection.
- Methods of sample collection (fecal material)
Unit V: Circulatory System (CS): 10 hours

- Blood: composition, functions of blood cells, Blood groups and fate of RBC, site of formation.
- Gross and microscopic structure of the different parts of the circulatory system.
- Different parts of the circulatory system and its function.
- Physiological changes in circulatory system in relation to infection.
- List the common pathological conditions in relation to infection.
- Methods of blood sample collection (blood)

References:


3. Chaursia, Handbook of Human anatomy. CBS publication

4. Anatomy and Physiology for Nurses


BPS 109.3 (Credit Hours 3)

**Biophysics**
B.Sc. Medical Biochemistry, First Year, Second Semester

**Course Objectives:**
Upon successful completion of the course, students will be able to:
- Understand the basic principles and applications of physics in biological systems.
- Understand the interactions between biomolecules.
- Understand the principle of radiation biology.

**Course contents**

**Unit I: Introduction:** 2 hours
Physics and biology: scope and methods of biophysics, levels of molecular organization.

**Unit II: Intermolecular Forces:** 8 hours
- Chemical and physical forces involved in chemical bond formation and molecules, mechanisms of bond formation pi-bond, covalent, electrostatic, co-ordinate bond, hydrophobic interaction and their properties,
- Intermolecular interactions, dipole-dipole interaction, ion-dipole interaction, ion-induced dipole and dipole-induced dipole interactions, the hydrogen bond,
- Chemical bonds between carbon and oxygen, and nitrogen and carbon with other atoms such as hydrogen, oxygen, sulphur,
- Structure and properties of water, structure of ice, structure of water, physiochemical properties of water.

**Unit III: Structural Biology - Role and Importance:** 14 hours

1. **Protein**
   - Understanding of structural protein at different level (primary, secondary, tertiary and quaternary).
   - Conformations of the poly peptide chain, helix-coil transitions, the protein globule and hydrophobic interactions,
   - The structure and stability of the globule, antibody and antigens, fibrous proteins.

2. **Enzymes**
   - Chemical kinetics and catalysis,
   - Kinetics of the simple enzymatic reactions,
   - Chemical aspects of enzyme action,
   - Conformational properties of enzymes,
   - Physics of enzyme substrate interactions,
   - Electronic conformational interactions, cooperative properties of enzymes.

3. **Nucleic acids**
   - Molecular biology and physics,
   - Structure of nucleic acids,
   - Intra-molecular interactions in the double helix,
   - Interaction of the double helix with small molecules and ions,
   - Replication of DNA.

4. **Membranes**
   - Organization of cell and mitochondria,
   - Cell membranes,
   - Structure of membranes,
   - Conformational properties of membranes,
   - Passive membrane transport,
5. Nerve Impulse  
- The axon and the nerve impulse,
- generation and propagation of the nerve impulse,
- ionic channels, synaptic transmission,
- EEG,
- ECG,
- EMG.

Unit IV: Radiation Biophysics  
- Radioactivity, decays laws, production of isotopic tracer method,
- Assay using radioactive substrate,
- Biological metabolic and physiological tracer studies, does response relationship,
- Labeling of molecules with radioactive substances,
- Artificial production of radioactivity and their uses in medicine,
- Effects of radiation on biomolecules and molecular structure,
- Radiation effect on cell and organisms,
- Neutron activation analysis of elements in human body,
- Radiation hazard and its protections.
- Detection methods using fluorescent molecules like biotin, rhodamin and other chromogenic compounds.

Unit V: Instrumental Methods of Analysis:  
- Ultra-centrifugation (Gradient centrifugation),
- Viscometry,
- UV-VIS absorption spectroscopy,
- Mass spectrophotometry,
- Light scattering,
- X-ray crystallography,
- Electron Spin Resonance,
- Basic principle of NMR, Application of NMR in the study of Biomolecules, NMR imaging and in vivo NMR spectro-microscopy.

References:  
Clinical Biochemistry I (Instrumentation)
B.Sc. Medical Biochemistry, First Year, Second Semester

Course Objectives:
Upon successful completion of the course, students will be able to:
- Understand the principle, use and precautions for using various instruments.
- Understand biochemical techniques (biotechnology), and biomedical engineering.

Course Contents:
Unit I: Biomedical Engineering: 3 hours
- Introduction: scope, importance.
- Principles and practices of biomedical engineering.
- Biological information transfer.

Unit II: Instrumentation: 35 hours
Introduction, principle types, importance, operation and care of biomedical instruments:
- Colorimeter and Spectrophotometer.
- Atomic absorption spectrophotometer.
- Spectroflurometer.
- Flame photometer.
- Centrifuge machines (hand and electric) ultra-centrifugation, ion selected electrode Crayo-centrifugation.
- Filtration.
- Distillation plant.
- Electrophoresis set.
- Auto analyzer.
- Blood gas analyzer.
- Micro cell counter.
- pH meter.
- Flow cytometer.
- Chromatography set.
- Analytic balance.
- Immuno fluorescence devices.

Unit III: Tissue Engineering: 6 hours
- Concepts of tissue engineering.

Unit IV: a. Electrical and other hazard, safety, standards 4 hours
b. Maintenance of equipments.
PRACTICAL WORKS

Physical Chemistry II
B. Sc. Medical Biochemistry, First Year, Second Semester

1. Study of the reaction between potassium persulphate and potassium iodide by Iodine clock method and determination of the activation energy.
2. Determination of the distribution coefficient of iodine between organic liquid and water.
3. Determination of the mutual solubility curve of phenol and water and hence determination of the upper consolute temperature.
4. Verification of the Ostwald’s dilution law by measuring the conductance of acetic acid at different concentration and determination of the ionization constant of the acid.
5. Determination of the equivalent conductance at infinite dilution of strong electrolyte by conductance measurement.
6. Study of the alkaline hydrolysis of ethyle acetate at two temperatures titrimetrically and hence determination of the energy of activation of the reaction.
7. Study of the adsorption of acetic acid from aqueous solution by activated charcoal and examination of the validity of Freundlich and Langmuir adsorption isotherm.
8. Determination of the concentration of halide mixture by potentiometric titration with silver nitrate.
10. Determination of the molecular weight of acetone.
11. Determination of the cell constant.

Organic Chemistry II
B. Sc. Medical Biochemistry, First Year, Second Semester

1. To separate the mixture of O-Nitrophenol and Nitrophenol by thin layer chromatography.
2. Purification of compounds by re-crystallization and by determining the melting point.
3. Extraction of essential oil from leaves of Eucalyptus plant.
4. Isolation of caffeine from the tealeaves and preparation of its derivatives.
5. To identify the given organic compound and prepare its derivatives and to check its melting points.
6. To study the photochemical reaction on Benzophenone.
7. Distillation under reduced pressure.
8. Filtration under partial vacuum.

Human Anatomy and Physiology I
B. Sc. Medical Biochemistry, First Year, Second Semester

1. Organization of human body- skeleton articulated and disarticulated.
2. Gross anatomy of the different systems of the body (anatomical position, skeletal and bones and muscle)-Dummy, Models, Chart.
3. Demonstration of different normal histological slides (MS, Skin, RS, GI, CS).
4. Measurement of Temperature, Pulse, BP
5. Demonstration of ECG/Echo and its interpretation techniques.
6. Blood sample collection by different methods
7. Demonstration of TLC, DLC, Hb% and ESR
8. ABO and Rh. blood group typing.

Clinical Biochemistry I (Instrumentation)
B. Sc. Medical Biochemistry, Second-Year, Third Semester

1. Handling of instruments with quality control assurance in biochemistry lab:
   - Colorimeter and Spectrophotometer,
   - Fluorimeter,
   - Flame photometer,
• Centrifuge,
• Distillation plant,
• pH meter.

2. Demonstration of handling of:
• Chromatography set
• Electrophoresis set
• Auto analyzer,
• Blood gas analyzer,
• Blood cell counter,
• Flow cytometer,
• Absorption spectrophotometer.
B.Sc. Medical Biochemistry
SECOND YEAR
Third Semester
BMO 201.3 (Credit hours 3)

Bio-molecules I
B.Sc. Medical Biochemistry, Second Year, Third Semester

Course Objectives:
Upon successful completion of the course, students will be able to understand the chemistry of biologically important compounds - carbohydrate and protein and amino acid.

Course Contents:

Unit I: Carbohydrates, Glycobiology and its Physiological Significance: 20 hours
- Definition, classification, sources, structure and properties, and biological importance, stereoisomerisms, anomier.
- Functional and clinical aspects of monosaccharide, disaccharide and polysaccharides.
- Isomerism in sugars
- Pentose, Proteoglycans, glycoprotein, mucopolysaccharides.
- Amino sugars, doxysugar, glycosides.
- Reaction with acid, amines, oxidizing agents, reducing agents, osazone formation.
- Detection of carbohydrate and analysis.

Unit II: Amino Acids, and Proteins: 20 hours
- Definition, classification and sources of protein.
  Amino acid:
  - Definition, classification, sources and properties, structure and reaction.
  - Essential and nonessential amino acids.
  - Amino acids and peptide, peptides and proteins, peptide bond.
  - Biomedical importance, biomedical importancs of peptides
  Proteins:
  - Properties (physical and chemical) and reactions, biomedical importance,
  - Isomerism in protein.
  - Structure: - Primary, secondary, tertiary, quaternary forms, complexes, protein folding,
  - Protein sequencing and chemical synthesis of peptides,
  Plasma proteins:
  - Composition and function
  - Brief account of Keratin, albumin, globulin, micro globulin, fibrinogen and collagen.
  Globular protein: Hemoglobin and myoglobin,
  - Structural, functional relationship with special references to-
    o Abnormal haemoglobins.,
    o Myoglobin,
    o Collagen
    o Denaturation and renaturation
  - Hemoglobin metabolism,
  - Immunoglobulin.
  - Separation and Characterization of Proteins, Covalen.

Unit III: Protein Purification 8 hours
• Methods of precipitation, extraction of protein, separation of protein.
• Gel exclusion chromatography,
• Ion – exchange chromatography,
• Affinity chromatography,
• Hydrophobic chromatography,
• Polyacrylamide gel electrophoresis, Isoelectric focusing,
• Activity staining.

References:


MET 202.3 (Credit hours 3)

Metabolism I
B.Sc. Biochemistry, Second Year, Third Semester

Course Objectives:
Upon successful completion of the course, students will be able to understand the fundamentals of metabolism of carbohydrate and protein, their regulation and pathways.

Course Contents:

Unit I: Metabolism of Carbohydrates: 24 hours

Digestion:
- Polysaccharides,
- Disaccharides,

Absorption:
- Absorption and mobilization,
- Conversion of other monosaccharides,
- Factor influencing the absorption,
- Defect in digestion and absorption,
- Utilization of glucose
- Blood glucose level and its control (regulation, homeostasis),
- Diabetes mellitus, Glucose storage disease, glycosuria, renal thrush hold, glucose tolerance,
- Glycolytic pathway and its significance (biomedical importance) and regulation,
- Glycogen metabolism,
- Role of ATP and other high energy compounds, mechanisms of ATP generation,
- Fates of pyruvate under aerobic and anaerobic conditions,
- Glycogenesis, regulation, biomedical importance
- Gluconeogenesis and its substrate,
- Feeder pathway of glycolysis,
- Pentose phosphate pathway, metabolic significance,
- Metabolism of fructose, galactose and lactose,
- Uronic acid pathway,
- Junction between glycolysis and citric acid cycle (TCA cycle) and its regulation, biomedical importance,
- Glyoxylate cycle (HbA1C) and biomedical importance,
- Mechanism of electron transport,
- Oxidative phosphorylation and regulation of ATP production.

Unit I: Metabolism of Amino acids and Proteins: 24 hours

- Digestion and absorption of proteins,
- Proteolytic enzymes,
- Biosynthesis and of non-essential amino acids,
- Amino acid pool
- Nitrogen balance
- Various pathways to metabolism of amino acids:
  - Deamination,
  - Transamination,
  - Decarboxylation,
- Racemization,
- \( \text{NH}_3 \) transport,
- Urea formation and clinical significance, inherited disorder with urea cycle,
- Fates of amino groups,
- Fates of amines,
- Degradation of amino acids (in brief)
- Metabolic disorders of protein and amino acids

Haemoglobin
- Metabolism, formation of bilirubin, urobilinogen, stercobilinogen and bile salt.
- Fate of haemoglobin metabolism.

References:
HAP 203-3 (Credit hours 3)

Human Anatomy and Physiology II
B.Sc. Medical Biochemistry, Second Year, Third Semester

Course Objectives:
Upon successful completion of the course, students will be able to:

- Describe basic human anatomy and physiology.
- Understand structures of various organs and system of human body.
- Understand various functions, physiology and infections of organs and systems.

Course Contents:
Unit I: Lympho-reticular System (LRS): 8 hours
- Different organs of LRS (Lymph, Lymphatic vessels and Lymph nodes)
- Gross and microscopic structure of Lympho-reticular system.
- Functions of the different organs of Lympho-reticular system.
- Physiological changes in Lympho-reticular system in relation to infection.
- List the common pathological conditions in relation to infection.

Unit II: Urinary System (US): 8 hours
- Different organs of Urinary System.
- Gross and microscopic structure of organs of Urinary System.
- Functions of the different organs of Urinary System.
- Mechanism of urine formation and composition of urine.
- Major signs and symptoms of infection of Urinary System.
- Physiological changes in infection.
- List the common pathological conditions in relation to infection.

Unit III: Endocrine System (ES): 8 hours
- Introduction to endocrine system.
- Different organs of endocrine system.
- Functions of endocrine system.
- Physiological changes in relation to infection.
- List the common pathological conditions in relation to infection.

Unit VI: Reproductive System (RS): 8 hours
- Different organs of male and female reproductive system.
- Gross and microscopic structure of male and female reproductive system.
- Functions of the different organs of male and female reproductive system.
- Physiological changes in male and female reproductive system in relation to infection.
- List the common pathological conditions in relation to infection.
- Method of sample collection (semen, HVS)

Unit V: Special Sensory Organs (SSS): 8 hours
- Introduction to special sensory organs.
- Functions and functions of eye, ear, nose, tongue, and skin.
- Physiological changes in infection of eye, ear, nose, tongue, and skin.
- List the common pathological conditions in relation to infection.
- Method of sample collection from organ. (Pus swab)
Unit VI: Nervous System (NS): 8 hours

- Introduction to nervous system.
- Different organs and function of central nervous system (CNS) and peripheral nervous system (PNS).
- Gross and microscopic structure of central nervous system (CNS) and peripheral nervous system (PNS).
- Physiological changes in central nervous system (CNS) and peripheral nervous system (PNS) in relation to infection.
- List the common pathological conditions in relation to infection.
- Method of sample collection (CSF)

References:


2. Chaursia, Handbook of Human anatomy. CBS publication

3. Anatomy and Physiology for Nurses


PTO 204.3 (Credit Hours 3)

Pharmacology and Toxicology
B.Sc. Medical Biochemistry, Second Year, Third Semester

Course Objectives:
Upon successful completion of the course, students will be able to:

- Understand basic pharmacology and toxicology along with therapeutic drug monitoring, treatment of common biochemical disorders and management of common poisoning.

Course Contents:

Unit I: Introduction to Pharmacology: 6 hours
- Pharmacology, pharmacotherapeutics and pharmacogenetics.
- Common terminologies in Pharmacology.
- Basic concept of pharmacokinetics and pharmacodynamics.
- Routes of drug administration.
- Factor affecting drug absorption.
- Concept of Adverse Drug Reaction and Drug Interaction.
- Classification of Drugs.

Unit II: Drug Metabolism and Enzyme Induction: 6 hours
- Basic concept of Drug Metabolism and Detoxification.
- Phases of Drug Metabolism.
- Factors affecting Drug Metabolism.

Unit III: Therapeutic Drug Monitoring: 6 hours
- Basic concept and principles of TDM.
- Importance of TDM.
- Factor Affecting TDM.
- Drugs requiring TDM.

Unit IV: Drugs Used in Biochemical Disorders: 10 hours
- Basic concept of biochemical disorders.
- Insulin, glucagon, and oral hypoglycemic agents.
- Adrenal steroids.
- Thyroid hormones and antithyroid hormones.
- Parathyroid hormones and Vitamin D.
- Posterior pituitary hormones.
- Anterior pituitary hormones.
- Drugs used in Gout.
- Antianemic drugs.
- Vitamins.

Unit V: Introduction to Toxicology: 6 hours
- Basic concept of toxicology and its scope and application.
- Common terminologies used in toxicology.
- Factors affecting toxicity of a xenobiotics.
- Toxic and toxicity, Toxicity value, Acute and Chronic toxicity.
- Toxicity categories- EPA, WHO, Personal protection equipments.
- Causes of poisoning, Poison Prevention.

Unit VI: Clinical Toxicology: 10 hours
• Initial approach to poisoned patients.
• Mechanism of action, clinical effects and management of poisoning due to OP, OC, pyrethrins, phosphides, paracetamol, benzodiazepines, barbiturates, opiates, TCA, iron, Datura, snake bites, bee/wasp/hornet sting, scorpion bites.

Unit VII: Environmental Toxicology: 4 hours
• Water and soil pollution
• Air pollution
• Risk assessment

References:
   Wall Chart on the Management of Commonly Encountered Poisons in Nepal, 2000
MBG 205.3 (Credit hours 3)

Microbiology I: General
B.Sc. Medical Biochemistry, Second Year, Third Semester

Course Objectives:
Upon successful completion of the course, students will be able to:
- Acquire knowledge on the Prokaryotic and Eukaryotic organisms.
- Define and describe different forms, features, morphology, classification and infection concerning with different groups of microorganisms.

Course Contents:

Unit I: Introduction of Microbiology 7 hours
- Scope and medical importance of microbiology.
- Discipline of microbiology and its multidisciplinary role (Medical, Food, Agricultural and Horticultural, Environmental and Public Health etc.).
- Modern concept of classification of microorganisms (nomenclature).
- Prokaryotic and Eukaryotic organisms.
- Germ theory of diseases, Spontaneous generation theory.
- Opportunistic and pathogenic organisms.
- Infection and mechanism of infection.

Unit II: Medical Bacteriology: 5 hours
- Introduction:- Bacteriology and medical bacteriology, size, shape and basic feature of bacteria, classification, nomenclature and characteristic of major groups of Medically importance bacteria.
- Pathogenic, nonpathogenic (Normal bacterial flora (Commensal))/ opportunistic bacteria.
- Bacterial infection.
- Bacterial growth factor and growth curve.

Unit III: Medical Virology: 15 hours
- Introduction: Virology and medical virology, Scope nature, shape, general properties including structure and chemical composition.
- Classification of medically important viruses, listing medically important DNA and RNA viruses.
- Genetic material and replication of Viruses
- Virus host interaction, Bacteriophage.
- Basic concept on viral transmission and infection and their prevention and control.
- Selection, collection, storage, transportation and processing of samples.
- Basic concept on virus isolation, inoculation, identification and recognition of growth, serological tests

Unit IV: Medical Parasitology: 5 hours
- Introduction: Parasitology and medical parasitology, definition, history, scope and medical importance of parasites
- Definition and classification of host.
• Definition and classification of parasites (protozoa, helminthes - intestinal, blood and tissue parasites).
• Host parasite relationship.

Unit V: Medical Mycology: 12 hours
Introduction: Mycology and medical mycology Scope, classification and characteristic of major groups of fungi and medical importance of fungi- Molds, Mushroom, Yeast.
• Morphology and structure of mould and yeast: Septate, aseptate, Plectenchyma, Prosenchyma, Pseudoparenchyma.
• Modification of Plectenchyma (Rhizomorph, Sclerotia, Stroma).
• Definition: Mycology, Medical Mycology, Mycetes, Mycosis, Thallus, Hypha, Mycelium, Coenocyte, Rhizoids and Club.

Pathogenic Group of Fungi: Basic concept on fungal infections and opportunistic pathogens:

• True pathogens
  a. Blastomyces dermatitidis
  b. Cooccidioides immittis
  c. Paracocidioides brasiliensis
  d. Histoplasma capsulatum.

Dermatophytes
  a. Microsporum (Hair, skin)
  b. Trichophytom (Skin, hair, nail)
  c. Epidermophytom (Skin, nail)
  d. Aspergillus spp

Dermatophycosis (Candida albicans, Cryptococcus neoformans)

• Isolation and identification (laboratory diagnosis) of fungus (molds and yeast)

Unit VI: Safety in Microbiology: 4 hours
• Laboratory contamination and laboratory associated infection,
• Classification of microorganisms on the basic of hazard,
• Disposable of infectious materials,
• Laboratory safety measures,
• Types of biological safety cabinets
• Laboratory discipline and practices

References:
6. Isenberg H. D., and Albert Clinical Microbiology Procedure Hand Book Vol. II, American Society for Microbiology, Einstein College of Medicine, New Work, Washington DC and I.


PRACTICAL WORKS

Bio-molecules I
B. Sc. Medical Biochemistry, Second Year Third Semester

1. Tests for carbohydrate:
   - Molish tests,
   - Iodine test,
   - Barford’s tests,
   - Seliwanoff’s test,
   - Fehling’s test,
   - Benedict’s test
   - Mucic acid test
   - Bial’s test.
2. Tests for the protein and amino acids:
   - Biuret test,
   - Ninhydrin test,
   - Xanthoproteic test,
   - Million’s test.
   - Hopkine’s cob test
3. Quantitative estimation of protein:
   - Folin’s method,
   - Lowry’s (Folin- Ciocateau) method,
   - Dye binding (Coomassie Brilliant) / Bradford method,
   - UV absorption method.
   - Silver binding method,
   - Turbid metric methods,
   - Sakaguchi reaction.
4. Estimation of total sugar:
   - Phenol sulphuric acid method.
   - O-toluidine method,
5. Estimation of ketohexoses (fructose) by resorcinol method,
6. Estimation of aldohexoses (glucose) by iodometric method.

Metabolism I
B. Sc. Medical Biochemistry, Second Year Third Semester

1. Analysis of urine:
   a. Physical examination,
   b. Microscopic examination,
   c. Chemical examination,
      - To determine glucose,
      - To detect ketone bodies,
      - To detect bilirubin urobilinogen and bile salt,
2. Extraction and estimation of liver and muscle glycogen
3. To determine total urine nitrogen by calorimetric method using Nessler's reagent.
4. To determine creatinine in urine.
5. To determine protein in urine (single specimen and 24 hours urine).
6. To determine amino acid in urine.

Human Anatomy and Physiology II
B. Sc. Medical Biochemistry, Second Year, Third Semester

1. Gross anatomy of the different systems of the body (anatomical position, skeletal and bones and muscle)-Dummy, Models, Chart.
2. Demonstration of different normal histological slides (LRS, VS, ES, RS, SSS, and NS)
3. Counting the blood cells (TLC, DLC)
4. Estimation of haemoglobin (Hb %) and erythrocyte sedimentation rate (ESR)
5. Measurement of blood pressure
6. Measurement of pulse

**Pharmacology and Toxicology**  
B.Sc. Medical Biochemistry, Second Year, Third Semester

1. Demonstration of drugs which need therapeutic monitoring (Phenobarbitone, Phenytion, Carbamazepine etc.)
2. Report on biomchemically important toxic substances.
3. Visited to forensic toxicology laboratory.
4. Case studies on drugs - laboratory tests interaction.
5. Case studies on common poisoning.

**Microbiology: General**  
B. Sc. Medical Biochemistry, Second Year, Third Semester

1. Handling of instruments in microbiology laboratory:
   - Microscope, autoclave, Hot-air oven, incubator, laminar flow hood, colony counter
2. Apply various sterilization technique, disinfectant solution, and follow aseptic techniques during procedure.
3. Preparation of smear from different samples / medium.
4. Preparation and use of different stains.
5. Study of morphology of microorganisms - using Gram staining and Ziehl Nelsen staining technique.
6. Sample collection, isolation and identification of fungus (skin scraping, KOH preparation, staining, observation, Germ tube test for *Candida*)
B. Sc. Medical Biochemistry
Second Year
Fourth Semester
BMO 206.3 (Credit hours 3)

Bio-molecules II
B.Sc. Medical Biochemistry, Second Year, Fourth Semester

Course Objectives:
Upon successful completion of the course, students will be able to understand and analysis the chemistry of biologically important compounds – lipid, nucleic acid and biological membrane.

Course Contents:

Unit II: Lipids: 13 hours
- Introduction, definition, classification and function, biomedical importance (glycerol, cholesterol, steroids, sphingolipid, phospholipids, glycolipids),
- Lipoproteins,
- Physiochemical properties and structural aspects of lipids, oils, waxes tri-glycerides, phospholipids, glycolipids,
- Properties: saponification and iodine number, rancidity, antioxidant, complex lipids and bile salts and bile acids,
- Steroid and its derivatives,
- Essential fatty acid, cholesterol, ecosanoids (prostaglandin), leukotriens and their biological significance.

Unit II: Biological Membranes and Transport: 13 hours
- Introduction of biological membrane
- Basic concept on cytoplasmic (plasma) membrane and cell wall,
- Study of biological membrane – fluid Mosaics model,
- Supramolecular architecture of membranes,
- Asymmetry of membrane lipid, arrangements of integral and peripheral protein in the membrane
- The molecular constituents of membranes,
- Movement of protein and lipid (solute transport across membranes).

Unit III: Cell: 4 hours
- Introduction to the cell,
- Cell growth,
- Cell organization,
- Cell adhesion, junction,
- Cell function and extra-cellular matrix.

Unit IV: Nucleotides and Nucleic Acids: 18 hours
- Definition of nucleic acid and nucleoprotein, functions of DNA and RNA,
- Nitrogen bases, nucleosides, nucleotides,
- Structure and function of nucleosides, nucleotides,
- Nucleoproteins,
- Types of DNA and RNA,
- Denaturation and hybridization,
- Molecular structure genes,
- DNA: Molecular structure, types:
  - Primary, secondary and tertiary
  - The Double helix, types
• RNA: Molecular structure, types.
• Evolution of DNA and RNA,
• Gene and genetic codes,
• Biologically important nucleotides, coenzymes.

References:
3. Chatterjea MN., Rana Shinde, Text Book of Medical Biochemistry 3rd, Jaypee Brothers Medical Publisher, P. Ltd. 1999.
Course Objectives:
- To understand the principal mechanisms of various carbohydrate and lipid metabolism.
- To be familiar with the regulation of central metabolic pathways and their importance in normal homeostasis.

Course Contents:
Unit I: Metabolism, Synthesis and Degradation of Lipids: 30 hours
- Lipid digestion, absorption, mobilization,
- Transport of fatty acids,
- Oxidation of fatty acids (β, α, ω)
- Ketone bodies,
- Biosynthesis of fatty acids,
- Triacylglycerides,
- Biosynthesis and degradation of phospholipids,
- Glycolipids,
- Diseases associated with lipid.

Unit II: Metabolism of Nucleotides (Nucleic Acid): 8 hours
Biosynthesis and degradation of nitrogenous bases, nucleosides, nucleotides, and diseases associated with their metabolism, nucleic acids (DNA and RNA), various types of nucleases, DNAses, RNAses.

Unit III: Metabolism of Purine and Pyrimidine: 10 hours
Biosynthesis, biomedical importance and degradation of Purine and Pyrimidine, Metabolic disorder of purine and pyrimidine metabolism, formation of uric acid and clinical significance.

Reference:
ENZ 208.3 (Credit Hours 3)

Enzymology
B.Sc. Medical Biochemistry, Second Year, Fourth Semester

Course Objectives:
Upon successful completion of the course, students will be able to:
- Understand the principles and mechanism of enzyme in living organisms.
- Perform various enzyme activities.
- Understand the significance of enzyme assays in diagnosis of diseases.

Course Contents:
Unit I: A. Enzymes: 8 hours
- Introduction definition, nomenclature and classification,
- Sources, properties and biological function (biomedical importance).
- Enzymes catalysis, theories of catalysis, enzymes as catalysts, activation energy and transition state, free energy change, active site, equilibrium of biochemical reactions, specificity- sterio-specificity (optical) substrate specificity. Mode of enzyme substrate complex formation, template or lock and key model, induce fit or Koshalad model.
B. Iso-enzymes: 3 hours
- Definition of isoenzyme, co-enzymes and co-factor, Units of Enzymes measurements
- Structure and biological function of coenzymes.

Unit II: Factor Affecting on Enzyme Activity: 6 hours
- Factors affecting enzymatic reaction velocity, and Michael-Menten Equation
- Substrate concentration, enzyme concentration, temperature, pH, coenzymes and prosthetic groups, vitamins (water soluble and fat soluble), isozymes, enzyme group of lysosome and biomedical importance.

Unit III: Enzyme Kinetics and Inhibition: 8 hours
- Mechanisms of enzyme actions.
- Michaelis-Menten hypothesis equation, Lineweaver-Burke-plot
- Inhibition (competitive, noncompetitive and allosteric), and, enzyme inhibition, irreversible inhibition, reversible competitive inhibition, reversible non-competitive inhibition.
- Mechanism of actions of chymotrypsin, lysozymes and carboxypeptidase’s. Nucleophilic and electrophonic attach group transfer reaction, roles of metal in enzyme action, metallo enzymes and activators. Multi-enzyme complex.

Unit IV: Control of Enzyme Activity (Enzyme Regulation): 5 hours
- Regulation of enzyme activity,
- Regulation of enzyme synthesis and breakdown, Allosteric and co-valent modification, enzyme induction and repression, product inhibition,
- Feedback regulation, reversible covalent modification, proteolytic activation.

Unit V: Enzyme Assays: 4 hours
- Enzyme catalysed reaction velocity, enzyme activity,
- Expression of enzyme activity units,
- Requirements for enzyme assays,
- Enzyme linked assays.
Unit VI: Enzymes and Co-enzymes of Clinical Importance: 8 hours
Amylase, Lipase, Lactate dehydrogenase, Alkaline phosphatase, Acid phosphatase, Aspartate and Alanine aminotransferase, Creatine phosphokinase.

Unit VII: Enzymes Extraction and Purification 6 hours
- Extraction of Lactate dehydrogenase and its purification, enzyme estimation,
- Specific activity, fold purification, Yield.
- Marker of enzymes purification.

References:
1. Hames, B. D; Hooper, N. M. and Houghton, J. D. Instant Notes in Biochemistry,
BEN 209.3 (Credit Hours 3)

Bioenergetics
B.Sc. Medical Biochemistry, Second Year, Fourth Semester

Course Objectives:
Upon successful completion of the course students will be able to understand the energy change accompanying biological reaction.

Course Contents:
Unit I: Introduction: 10 hours
Definition, Principle of bioenergetics, Free energy, Gibbs free energy, Change in free energy, Enthalpy, Entropy, Exergonic reaction, endergonic reaction, Laws of Thermodynamics, Standard free energy change, Actual free energy change, Biomedical Importance of Bioenergetics.

Unit II: Metabolism: 4 hours
Catabolism, anabolism, intermediary Metabolism, Energy relationships between catabolism and anabolism, Types of metabolic pathways

Unit III: Types of Reaction in Living Cells: 2 hours
Oxidation reaction, Reaction that makes or breaks carbon – carbon bond, Isomerization and elimination, group transfer, Free radical reaction.

Unit IV: High Energy Phosphate Compounds: 4 hours
Its concepts, role and free energy sources in biological system, Energy currency of the cell, Phosphate transfer potential and the central role of ATP as a free energy currency, Internal energy and the state of a system, the first law of thermodynamics Enthalpy Entropy and the second law of thermodynamics: Free energy and chemical reactions: Chemical equilibrium

Unit VI: Biological Oxidation: 4 hours
Introduction, Biomedical Importance, Redox Potential, Enzymes involved in oxidation and reduction.

Unit VII: The Respiratory Chain and Oxidative Phosphorylation: 15 hours
Introduction, Respiratory chain, Energy captured in the respiratory Chain, Oxidative phosphorylation, Coenzymes Q, Structure of Mitochondria, Anatomy and function of Mitochondrial Membrane, Mitochondrial Transport System, Poisons that inhibits respiratory chain, Chemiosmotic theory, ATP synthesis, ATP synthase, Uncouplers, Shuttle system, Regulation of Oxidative phosphorylation, Clinical Importance, Cyclic AMP and GMP.

Unit VIII: Photosynthesis: 9 hours

References:
MBP 210.3 (Credit Hours 3)

Microbiology: Parasitology
B.Sc. Medical Biochemistry, Second Year, Fourth Semester

Course Objectives:
Upon successful completion of the course, students will be able to:
- Understand parasitology along with mode of infection, pathogenesis, laboratory diagnosis, prevention, and control of human parasites.

Course Contents:
Unit I: Introductory: 4 hours
- Definition, scope and classification of parasites and parasitology,
- Human and medically important parasites,
  - Protozoa- Blood, Tissue and Intestinal,
  - Platyhelminthes,
  - Nemathelminthes.

Unit II: Mode of infection, pathogenesis, laboratory diagnosis, prevention and control of intestinal parasites:
Protozoa: 12 hours
- *Entamoeba histolytica*,
- *Giardia lamblia*,
- *Trichomonas spp.*,  
- *Cryptosporidium*,
- *Cyclospora*.

Helminthes: 16 hours
- *Ascaris spp.*
- Hook worm: *Anacyclostoma and Necator*,
- *Enterobius vermicularis*,
- *Trichuris trichuris*,
- *Strongyloides spp.*

Trematodes/cystodes:
- Tapeworms ( *Taenia, Hymenolepis*)
- *Paragonimus*,
- Liver fluke,
- *Cystosomes*.

Unit III: Blood and Tissue Parasites: 16 hours
Mode of infection, pathogenesis, laboratory diagnosis, prevention and control of:
- *Plasmodium spp.*,  
- Leishmania,
- *Wuchereria, Bragia, Loa loa*,
- *Echinococcus spp.*

References:


PRACTICAL WORKS

Bio-molecules II
B. Sc. Medical Biochemistry, Second Year, Fourth Semester

1. Extraction and estimation of lipid content from given samples.
2. Qualitative test for glycerol, bromine water test, Acoline test
3. Determination of acid value of fat and oil.
4. Determination of saponification value of fat and oil.
5. Determination of iodine number of fat sample.
6. Quantitative test for the presence of fatty acids by titrimetric method.
7. Demonstration of extraction and quantization of DNA and RNA by oriccal and rocerceical methods

Metabolism II
B. Sc. Medical Biochemistry, Second Year, Fourth Semester

1. Determination of pyruvic acid in blood.
2. Determination of lactic acid in muscle.
4. Separation and identification of various lipids by column chromatography.
5. Detection of phenyl ketonuria and cystinuria by paper chromatography.
6. Separation various lipids by thin layer chromatography.
7. Determination of action of bile acids on emulsion of fats.

Enzymology
B.Sc. Medical Biochemistry, Second Year, Fourth Semester

1. Study of enzymatic action of lipase from pancreas.
2. Extraction of lactic hydrogenase (LDH) from liver.
3. Purification of LDH.
4. Estimation of km and V max of enzymes
5. Detection of α-amylase of saliva.
6. Examination of effect of temperature on α-amylase activity of saliva.
7. Examination of effect of pH on activity of pepsin and α-amylase.
8. Examination of effect of activators and inhibitors on α-amylase activity.
9. Quantitative estimation of glucose 6 phosphate dhydrogenase (G6PD) from blood sample.

Microbiology: Parasitology
B.Sc. Medical Biochemistry, Second Year, Fourth Semester

1. Collection, preservation and transportation of samples.
2. Examination of stool: physical, chemical and microscopic.
4. Detection of OPC by concentration techniques: floatation and sedimentation
5. Laboratory diagnosis, of the intestinal and vaginal parasites by various techniques: (Entamoeba histolytica, Giardia lamblia, Trichomonas spp, Cryptosporidium, Cyclospora, Ascaries spp, Hook worm: Enterobius vermicularis, Trichuris trichuria, Strongloides spp, Taenia spp, Echinococcus spp, Hymonolepis nana
6. Thick and thin blood smear preparation for blood and tissue parasites (Malaria sps., Kalaazar, Microfilaria) and microscopic observation.
B. Sc. Medical Biochemistry
THIRD YEAR
Fifth Semester
MBI 301.3 (Credit hours 3)

Molecular Biology
B. Sc. Medical Biochemistry, Third Year, Fifth Semester

Course Objectives:
Upon successful completion of the course, students will be able to:
- Understand the basic concept of molecular biology.
- Understand the molecular nature, replication, gene expression and recombinant DNA.

Course Contents:
Unit I: Introduction: 6 hours
- Introduction to molecular biology,
- General concept on molecular biology of cell,- molecular genetics,
- Microbial genetics. Application microbial genetics
- Evolution and molecular structure of cell and its organelles.

Unit II: Regulation of Gene Expression: 10 hours
- DNA replication: semi conservative nature of DNA replication,
- DNA replication in prokaryotic cells,
- Introduction to DNA replication in Eukaryotic cell (in brief),
- Enzymes involved in DNA replication: DNA polymerases,
- Proofreading, post-replication modification of DNA.

Unit III: Transcription: 10 hours
- Transferring information from DNA to RNA,
- Synthesis of RNA.
- RNA polymerase,
- Initiation and termination of transcription,
- Post transcription modification of the RNA.

Unit IV: Concept on: 12 hours
a. Gene, genetic code and regulation of the gene expression,
b. Regulating the Metabolism:
   - The Lac- Operon system,
   - Catabolic repression,
   - The Trp Operon system: regulating the biosynthesis of the tryptophan.
   - Gene expression in prokaryotic and eukaryotic cells,
- Plasmids: types, maintenance and functions.

Unit IV: Protein Biosynthesis: 10 hours
- Translation of the genetic code,
- Translation of mRNA,
- Role of RNA in protein synthesis,
- Forming the polypeptides elongation,
- Termination of the protein biosynthesis.

References:
2. B D Singh, Fundamental of Genetics, Kalyani Publishers 2000, India


Biotechnology
B. Sc. Medical Biochemistry, Third Year, Fifth Semester

Course Objectives:
Upon successful completion of the course, students will be able to:
- Recognize the foundation of modern biotechnology,
- Appreciate role played by biotechnology in improving life of human beings,
- Know about the application of biotechnology in medicine, agriculture and environment.

Course Contents:
Unit I: Introduction: 4 hours
- Biotechnology past- historical background,
- Biotechnology present,
- Application of biotechnology.

Unit II: Gene Cloning and Recombinant DNA Technology: 22 hours
- Gene Cloning: Introduction, definition and importance and principles
- Cloning, protoplast fusion and DNA for cloning,
- Formation of the Recombinant DNA, vehicles for cloning-plasmid and bacteriophage,
- Purification of DNA from living cells,
- Preparation of total cell DNA, plasmid DNA and bacteriophage DNA,
- Manipulation of purified DNA-Nucleases, Ligases, Polymerases, Modifying enzymes, Topoisomerases,
- Enzymes for cutting DNA-restriction endonucleases, restriction mapping.
- Use of micro projectiles (biolistics)
- Cloning vectors for animal cell, expression vectors,
- Detection of the recombinant DNA,
- Cloning the Eukaryotic genes in bacteria,
- Benefit and risk recombinant DNA technology.

Unit III: Mutations: 8 hours
- Definition and types of mutation (Lethal mutation, Nutritional mutation, Base substitution, Missense mutation, Silent mutation, Nonsense mutation, Frame shift situation, Suppressor Mutation),
- Mutation rates,
- Detection of mutants: replica plating; complementation,
- Mutagenic agents (Radiation, Chemical mutagens), Ames tests; Photo-reactivation,
- Recombination: Types (homologous and nonhomologous, Transposable genetic elements, Insertion sequence, Transposon, Transposon mutagenesis.

Unit IV: DNA Transfer in Prokaryotes: 2 hours
- Transformation,
- Transduction: generalized and specialized,
- Conjugations.

Unit V: Genetic Mapping: 6 hour
Basic idea on operational principles of molecular techniques and genetic mapping:
• Extraction of DNA, RNA and plasmids,
• PCR (conventional, semi nested and real time)
• PFGE,
• DNA Finger printing,
• Western, Southern and Northern Blotting,
• DNA sequencing.

Unit VI: Basic Concept Importance and Application: 4 hours
• Gene cloning in Medicine,
• Gene cloning in Agriculture,
• Mammalian cell culture,

Unit VII: Regulatory Issues in Biotechnology: 2 hours
• Bio-safety,
• Intellectual property right (IPR),
• Patents in biotechnology,
• Ethical issues.

References:
NBC 303.3 (Credit hours 3)

Nutritional Biochemistry
B.Sc. Medical Biochemistry, Third Year, Fifth Semester

Course Objectives:
Upon successful completion of the course students will be able to understand the balance diet and chemistry and metabolism macronutrients, elements and vitamins.

Course Contents:
Unit I: Introduction: 3 hours
Scope, definition, classification of nutrition, balance diet and its medical importance, malnutrition and associated diseases.

Unit II: Macronutrients: 8 hours
- Macronutrients and their Metabolism
- Dietary Fiber; Lipids, Lipoproteins, and Cardiovascular Disease Risk

Unit III: Minerals and Its Importance: 10 hours
- Calcium, Phosphorous,
- Sodium, Potassium, and Chloride,
- Iron, Zinc, Copper,
- Selenium, Chromium,
- Iodine, Manganese,
- Molybdenum, Fluorine.

Unit IV: Ultra Trace Elements and importance: 6 hours
Nickel, Silicon, Vanadium, Arsenic, Boron, Cobalt

Unit V: Homeostatic Maintenance of Nutrition: 6 hours
- Body fluid and electrolyte balance, Body composition and energy expenditure:
- Nutrition and the central nervous system,
- Nutrition knowledge base
- Parental nutrition

Unit V: Vitamins: 15 hours
- Definition, history, classification, water and fat-soluble vitamin, source and chemistry,
- Absorption, synthesis, storage and transport,
- Daily requirements of various vitamins, biomedical importance (function), effect of excess of various vitamins.
- Clinical sign and symptoms and diseased in deficiency of various vitamins.

References:
CBC 304.3 (Credit hours 3)

Clinical Biochemistry II
(B. Sc. Medical Biochemistry, Third Year, Fifth Semester)

Course Objectives:
Upon successful completion of the course, students will be able to:
- Understand the general principles of clinical biochemistry and its role in medicine.
- List the different organ function tests in clinical biochemistry lab.

Course Contents:

Unit I: Introduction: 6 hours
- Concept of pathological biochemistry and its problems,
- Diagnostic biochemistry, methodology and object of investigation,
- Application in diagnostic biochemistry, organ biochemistry,
- Concept of normal range and reference range in clinical biochemistry.

Unit II: Acid-Base Physiology: 10 hours
- Plasma bicarbonate, standard bicarbonate, base excess, partial pressure,
- Normal values of pO$_2$, pCO$_2$, pH,
- Metabolic acidosis, respiratory acidosis,
- Respiratory alkalosis, metabolic alkalosis;
- Oxygen content, oxygen saturation, pKa, acidemia, alkalemia, compensated and non-compensated;
- Function of haemoglobin and properties of dissociation curve of oxyhaemoglobin (effect of pH, pCo$_2$, temperature and 2-3 DPG), correlation with cyanosis;
- Different forms of carbon dioxide existence in blood and mechanism of transport;
- Interrelationship among Hb, O$_2$, CO$_2$, H+ and 2-3 DPG;
- Anion gap and its significance;
- Regulation of acid base balance by kidneys.

Unit III: Kidney: 6 hours
- Characteristic features and metabolism of kidney cells,
- Renal function test and their list with principle, procedures and interpretations,
- Creatinine clearance tests,
- Renal failure and its consequences.

Unit IV: Liver: 6 hours
- Characteristic features and metabolism of liver,
- Role of liver in metabolism of carbohydrates, lipids, proteins and foreign toxic substances,
- Types of jaundices and their biochemical features,
- Liver function test and their list with principle procedures and interpretations.

Unit V: Heart: 4 hours
- Characteristics features of heart muscles and its metabolism;
- Ischaemic heart disease,
- Infarct of myocardial muscle,
- Atherosclerosis,
- Pre-disposing factors leading to ischemia and infarction;
- Role of serum lipoproteins in transport of lipids in normal and pathology.
Unit VI: Brain: 4 hours
- Brief introduction to chemical composition of brain tissues and cerebrospinal fluid;
- Peculiarities of brain metabolism;
- Basic neurotransmitters and mechanism of synaptic transmission of impulses.

Unit VII: Pancreas: 2 hours
- Exocrine functions of pancreas;
- Pancreas function tests with their list and clinical significance;
- Biochemical tests for steatorrhoea.

Unit VIII: Gastrointestinal System: 4 hours
- Chemical composition of gastric juice;
- Biochemical methods of investigation conditions and regulation of gastric secretion.

Unit IX: Introduction to Inherited Metabolic Disorders: 6 hours
- Biochemical basis of galactosemia,
- Fructosemia,
- Aminoaciduria,
- Phenylketoneuria,
- Tyrosinuria,
- Cystinosis
- Cystinuria.

References:


4. *Varley’s Biochemistry*. 
MBB 305.3 (Credit hours 3)

Microbiology: Bacteriology
B. Sc. Medical Biochemistry, Third Year, Fifth Semester

Course Objectives:
Upon successful completion of the course, students will be able to:

- Find the factors influencing growth and microbial physiology of microorganisms.
- Describe cultivation, growth and identification of different groups of microorganisms.
- Understand basic concept on systematic bacteriology.

Course Contents:
Unit I: Physiology and Growth of Bacteria: 7 hours
- Bacterial reproduction,
- Growth of microorganism,
- Bacterial physiology and factors affecting the microbial growth:
  a. Nutrition (source of carbon nitrogen, mineral and other sources of vitamin),
  b. Temperature,
  c. Water activity,
  d. Salinity (osmotic effect and electrolytes),
  e. pH,
  f. Gases (aerobic, anaerobic, facultative anaerobic, micro-aerophilic, carbon dioxide),
- Growth curve,
- Host Parasite interaction,
- Microbial interactions, and mechanism of infection,

Unit II: Metabolism and Metabolic Product of Microorganisms: 10 hours
- Nutritional types (Photolithotropic, Chemolithiotropic, Photoorganotrophic chemoorganotrophic, microbial energetic).
- Carbon metabolisms-general concept of glycolysis and TCA cycle.
- Biochemical properties of microorganisms.
- Various metabolic product and identification.

Unit III: Basic Concept on Systemic Bacteriology: 10 hours
- Gram positive and negative, aerobic and anaerobic cocci,
- Gram positive and negative, aerobic and anaerobic bacilli,
- Aerobic non-spore forming gram positive bacilli,
- Gram negative bacilli-non-fermentative and coco-bacilli,
- Facultative anaerobic bacilli and aerobic coco-bacilli,
- Vibriniaceae family,
- Aerobic facultative spore forming bacilli
- Spirochetes.

Unit III: Biohazards and Bio-safety in Microbiology: 4 hours
- Basic concept on biohazard and bio-safety.
- Universal precaution.
- Laboratory waste products and disposal.

Unit III: Culture Media and Cultivation of the Microorganisms: 4 hours
- Various culture media (types, forms, composition, selection and uses),
• Various culture techniques.

Unit IV: Sterilization Techniques: 4 hours
• Structure, model, working principal and procedure of hot air oven, autoclave, incubator, bio-safety hood, steam sterilizer,
• Principle and procedure of various sterilization methods - Physical and mechanical (dry heat, moist heat, radiation and filtration, and incineration)
• Chemical sterilization.
• Biological sterilization.

Unit IV: Instruments: 6 hours
Microscope— types, handling and cure, general introduction and principle
Autoclave, hot air oven and incubator, laminar flow hood- types, handling and cure, general introduction and principle

Unit V: Identification of Bacteria: 3 hours
• Inoculation, isolation and identification-
• Various staining techniques and principle and uses (types, forms, composition, selection and uses).

References:

2. Isenberg H. D., and Albert Clinical Microbiology Procedure Hand Book Vol. II, American Society for Microbiology, Einstein College of Medicine, New Work, Washington DC


PRACTICAL WORKS

Molecular Biology and Biotechnology
B.Sc. Medical Biochemistry, Third Year, Fifth Semester

1. Preparation of various chemical and reagent using molecular work.
2. Extraction and quantization of Plasmid, DNA, RNA
   a. Plasmid isolation.
   b. Genomic DNA isolation.
   c. Plant DNA isolation.
   d. Complete restriction digestion.
   e. Partial restriction digestion.
   f. Quantization of DNA.
3. Extraction of the DNA and Plasmids from bacteria.
4. DNA Electrophoresis by
   a. PAGE,
   b. SDS-PAGE,
   c. Agarose gel.
5. Demonstration of PCR.

Nutritional Biochemistry
B.Sc. Medical Biochemistry Third Year, Fifth Semester

1. Estimation of β-carotene in carrots.
3. Estimation of ascorbic acid in lemon juice.
5. Identification of calcium and phosphorous.
6. Qualitative and quantitative estimation of Fe, Mg, and other elements by using adsorbed spectrophotometer and manual method.

Clinical Biochemistry II
B.Sc. Medical Biochemistry, Third Year, Fifth Semester

1. Collection of specimen for clinical biochemistry laboratory.
2. Urine analysis: Physical, chemical and microscopic
3. Blood analysis:
   a. Blood glucose,
   b. Serum cholesterol,
   c. Serum urea and creatinine,
   d. Serum bilirubin,
   e. Serum total protein, Albumen and Globulin
   f. Serum uric acid,
   g. Serum amylase

Microbiology: Bacteriology
B.Sc. Medical Biochemistry, Third Year, Fifth Semester

1. Sample collection, preservation and transportation of samples.
2. Preparation and use of different stains and media in bacteriology laboratory.
3. Isolation and identification of bacteria from various clinical samples and anti-microbial susceptibility testing.
CBC 306.3 (Credit Hours 3)

Clinical Biochemistry III
B.Sc. Medical Biochemistry, Third Year, Sixth Semester

Course Objectives:
Upon successful completion of the course, students will be able to:
• Understand general principles of clinical biochemistry.
• Listing the different hormone assay and tumor marker tests used in clinical biochemistry.
• Performed important biochemical tests that are available in the context of Nepal.

Course Contents:
Unit I: Calcium and Phosphorus Metabolism: 4 hours
• Distribution of calcium and phosphorus in body and dietary sources,
• Absorption and excretion of calcium and phosphorus,
• Biological roles of calcium (neuromuscular, blood coagulation, membrane, enzyme regulation, release of hormone),
• Role of vitamin D in calcium homeostasis,
• Sites and mode of action of vitamin D,
• Source, site and mode of action and control of secretion of calcitonin,
• Source and physiological functions and control of parathormone (PTH),
• Diseases associated with hyper and hypocalcaemia and hypo and hyperphosphataemia,
• Method of estimation of serum calcium, phosphate, vitamin-D, PTH and calcitonin.

Unit II: Iron Metabolism: 6 hours
• Iron containing haem and non haem proteins and their functions,
• Intestinal absorption of iron,
• Distribution kinetics in the body,
• Process of haem biosynthesis and catabolism,
• Iron deficiency anaemia and acute intermittent porphyria,
• Diagnostic test for iron deficiency states (serum-iron, serum iron binding capacity and serum ferritin),
• Classification of porphyria, causes, diagnosis and management of porphyria

Unit III: Sodium and Potassium: 4 hours
• Distribution water, sodium and potassium in the body;
• Interrelationship between water, sodium and extra-cellular fluid and osmolality;
• Role of aldosterone and natriuretic peptide hormones in maintaining ECF osmolality;
• Causes of water and sodium depletion,
• Water and sodium excess; causes of hyponatraemia and hypernatraemia and their measurement,
• Causes of hypo and hypokalaemia.

Unit IV: Muscle Metabolism 4 hours
• Creatine phosphokinase,
• P. Troponin
• Physiology of muscle and role of potassium
Unit V: Endocrinology: 24 hours

- Introduction and biomedical importance of hormones,
- Mechanism of action of hormones,
- Bio-signaling and signal transduction mechanisms
- Secretion of hormones,
- Endocrine disorders,

1. Hypothalamic-Pituitary Hormone:
   - Hypothalamic releasing factors and their functions,
   - Pituitary hormones (both anterior and posterior) their functions hyper and hypo conditions,
   - Methods of biological investigations.

2. Adrenal Hormone:
   Biochemical synthesis of Glucorticoid and mineralocorticotid,
   Functions and regulation Hypo and hyper conditions.

3. Steroid Hormone:
   - Receptor models of steroid hormones and peptide hormones,
   - Steroidogenesis,
   - Regulation and functional zones of the adrenal glands,
   - Causes, clinical features and biochemical investigations of Addison’s disease, Cushing’s syndrome and Conn’s Syndrome,
   - Biological actions and regulation of adrenal steroids androgens, estrogens, progesterone,
   - Male and female reproductive hormones.

4. Thyroid Hormone:
   - Formation of T₃, T₄ and their function and regulation,
   - Hypothyroidism, hyperthyroidism, thyroiditis and goiter (causes, molecular basis and biochemical investigation).

5. Pancreatic Hormone:
   - Mode of action and biological functions of insulin,
   - Glucagons and somatostatin,
   - Diabetes mellitus, it’s type, biochemical investigation and interpretation,
   - Metabolic interrelationships of tissues in obesity, exercise, pregnancy, stress, injury, liver disease, renal disease and acid-base disorder,
   - Kwashiorkor (protein malnutrition),
   - Reye’s syndrome (hepatic mitochondrial damage) and hyper-osmolar hyper-glycaemic coma.

Unit VI: Agents Causing Cancer (Tumor Marker): 6 hours

- Introduction,
- Chemical carcinogens and their mechanism of action,
- Clinical application of tumor markers,
- Specific tumor markers: enzymes, hormones, oncofetal antigens, carbohydrates and genetic markers.

References:
3. Harper’s Biochemistry
EPI 307.3 (Credit hours 3)

Epidemiology
B.Sc. Medical Biochemistry, Third Year, Sixth Semester

Course Objectives:
Upon successful completion of the course, students will be able to:
- Understand principles, concepts, approaches and methods used in epidemiology of microbial diseases.
- Appropriate use of epidemiological tools in investigations.

Course Contents:
Unit I: Introduction to Principles of Epidemiology: 2 hours
- History, Definition, and scope of epidemiology,
- Achievements in epidemiology,
- Terms and Terminologies used in epidemiology.

Unit II: Measuring Health and Disease: 4 hours
- Definitions of health and disease,
- Measures of disease frequency,
- Use of available information,
- Comparing disease occurrence.

Unit III: Concept of Epidemiological Study: 12 hours
- Basic concepts of epidemiology,
- Descriptive / Analytical,
- Applied/Experimental,
- Field Epidemiology.

Unit IV: Concept of Prevention and Control of Diseases: 12 hours
- Causation in epidemiology,
  - The concept of cause,
  - Establishing the cause of a disease,
  - Epidemiological markers,
  - Phenotypic and genetic markers including molecular epidemiology.
- Disease surveillance,
  - Clinical,
  - Laboratory.

Unit V: Applied Epidemiology: 14 hours
- Community medicine, hygiene and sanitation
- Communicable disease Epidemiology,
- Clinical Epidemiology,
- Environmental and occupational Epidemiology,
- Nutritional Epidemiology,
- Reproductive Epidemiology,
- Social Epidemiology,
- Food Epidemiology.

Unit VI: Epidemiology, Health Services and Health Policy: 4 hours
- Health care planning, Monitoring and evaluation,
- The planning cycle,
- Epidemiology, public policy and health policy,
- Healthy public policy in practice.
Environmental safety and biohazards

References:
CBC 308.3 (Credit hours 3)

Clinical Biochemistry IV (Analytical)
B.Sc. Medical Biochemistry, Third Year, Sixth Semester

Course Objectives:
This course aims to provide students with an opportunity to understand the basic analytical techniques used in biochemical investigation.

Course Contents:
Unit I: General Principles of Biochemical Investigation: 4 hours
Methods of investigating metabolism, In vivo model, In vitro model.

Unit II: Immunochemical Techniques: 6 hours
Production and separation of antibodies (polyclonal and monoclonal), Purification and fragmentation of immunoglobulin, Immunoprecipitation, Labeling antibodies, Immunoblotting, Immunooassay – ELISA, RIA, Immunohistochemistry, Affinity and avidity, Immunochemical use of surface plasmon resonance.

Unit III: Spectroscopic Techniques: Atomic and Molecular Electronic Spectroscopy: 6 hours
Introduction, Flame photometry, Gamma ray spectroscopy and Gamma ray resonance spectroscopy, X-ray spectroscopy, UV and visible light spectroscopy, Spectrofluorimetry, Circular dichroism spectroscopy, Turbidimetry and nephelometry, Luminometry, Atomic spectroscopy, Lasers.

Unit IV: Vibrational Spectroscopy and Electron and Neutron Spin Orientation in Magnetic Field: 6 hours
Introduction, Infrared and Raman spectroscopy, Electron spins resonance spectroscopy, Nuclear magnetic resonance spectroscopy.

Unit VI: Mass Spectrometric Techniques: 6 hours

Unit VII: Radioisotope Techniques: 8 hours
Detection and measurement of radioactivity, Other practical aspects of counting radioactivity and analysis of data, Inherent advantages and restrictions of radiotracer experiments, Safety aspects, Applications of radioisotopes in the biological sciences, Radioisotope calculations.

Unit VIII: Centrifugation Techniques: 6 hours
Introduction, Basic principles of sedimentation, Centrifuges and their use, Design and care of preparative rotors, Sample containers, Separation methods in preparative ultra centrifuges, Performing density gradients separation, Selection efficiency and applications of preparative rotors, Analysis of sub cellular fractions, Some application of the analytical ultra centrifuge, Safety aspects in the use of centrifuges.

Unit IX: Electrochemical Techniques: 6 hours

Unit X: Chromatography Techniques:
Introduction, Principles of Chromatographic techniques, precaution and importance.

References:
RME 309.3 (Credit hours 3)

Research Methodology
B. Sc. Medical Biochemistry, Third Year, Sixth Semester

Course Objectives
Upon successful completion of the course, students will be able to:
- Identify the problems and conducting health research following research methodology, collect appropriate data analyze available data, write a report, and prepare a research proposal.

Course Contents
Unit I: Introduction to Research Methodology: 4 hours
- Meaning and Nature of Research:
  o Meaning, definition and characteristics of health research
  o Importance of health research in nursing field.
- Foundation of Scientific Research:

Unit II: Identification and Analysis of Research Problem: 4 hours
- Selection of a problem,
- Sources Criteria, Defining a problem, Characteristics of a problem,
- Criteria of good research questions,
- Steps in analyzing the research problem.

Unit III: Proposal Development: 2 hours
- Basic steps involved in the health research proposal development process

Unit IV: Literature Review: 2 hours
- Importance and Sources,
- Strategies for gaining access to information, Library search, Computer search.

Unit V: Research Title and Objectives: 2 hours
- Criteria for selecting a research title,
- Formulation of research objectives,
- Types of research objectives,
- Qualities of research objective.

Unit VI: Research Hypothesis: 2 hours
- Definition,
- Qualities of research hypothesis,
- Importance and types of research hypothesis.

Unit VII: Variables: 2 hours
- Definition, Importance, Qualitative and Quantitative variables
- Dependent and Independent variables,
- Confounding variables, Background variables,
- Operational definition (defining variables), Indicator.

Unit VIII: Research Design 6 hours
• Purpose of research design
• Types of study designs: Interventional study design - Exploratory, Descriptive (case study / case series, cross-sectional, longitudinal), Analytical (case control, cohort) study designs; Non Interventional study design - Pre experimental (pre test post test), Quasi experimental, True experimental (Completely Randomized, Completely Randomized Block, Factorial, Time Series) study designs.

Unit IX: Sampling Design and Procedure 6 hours
• Definition, Importance, Characteristics of a good sample,
• Qualities of sampling frame, Population concept and parameter, Types of sampling units,
• Types of Sampling – non-probability sampling (purposive, quota, convenient, snowball etc.), Probability sampling (simple random, systematic, stratified, cluster, multistage, PPS etc.),
• Techniques to choose appropriate sampling procedure, Sampling errors, Sample size, testing reliability of sample.

Unit X: Qualitative and Quantitative Techniques used in Health Research Process: 2 hours

Unit XI: Test Instruments: 6 hours
• Types of questionnaire and types of questions, Steps in designing a questionnaire
• Types of observation, Observation check list preparation,
• Types of Interview, Steps to carry out an interview,
• Techniques to carry out focus group discussion (FGD),
• Nominal Group Technique, Delphi Technique,
• Rapid Appraisal Technique.

Unit XII: Data Collection Methods: 4 hours
• Secondary method of data collection (data from office records of institutions, journals, bulletins, annual reports, Med-line, Pop-line, Internet etc.),
• Primary method of data collection (observation, Interview through questionnaire, Group interview, FGD),
• Techniques to choose appropriate data collection technique.

Unit XIII: Pre-testing Data Collection Tools and Making Work Plan: 2 hours
• Preparation of working schedule,
• Gantt chart.

Unit XIV: Data Processing and Analysis: 2 hours
• Coding/decoding, Editing,
• Preparation of master tables,
• Master field books, Dummy table preparation,
• Data processing and analysis plan– Selection of appropriate statistical techniques.

Unit XV: Research Ethics and Research Proposal Format: 2 hours
• Principles of research ethics,
• National ethical guidelines of health research.

References:


MBI 310-3 (Credit hours 3)

Microbiology: Immunology
(B.Sc. Medical Biochemistry, Third Year, Sixth Semester)

Course Objectives:
Upon successful completion of the course, students will be able to:

- Understand immunology, basic components and principles of immunity
- Explain structure of antibody and antigen and its role in immunology.
- Know immuno-diagnostic techniques and adapt recent developments in immunology.

Course Contents:
Unit I: Introduction: 12 hours
1. Development and functions of immune system:
   - Definition and defense mechanism of immunity: memory, specificity, diversity, self vs non-self discrimination.
   - Types of immunity: Humoral and cell mediated, specific and non-specific, native and acquired immunity.
2. Cells involved in immune system:
   - Phagocytes,
   - Natural killer cells,
   - Mast cells and basophiles,
   - Dendritic cells,
   - Lymphocytes - T and B lymphocyte,
   - Lymphoid tissue,
   - Origin and maturation of immune cells, T-cells, B-cells,
   - Cytokines.
   - Concepts on:
     - Innate immunity,
     - Acquired immunity,
     - T-Cell mediated immune response,
     - B-Cell Mediated (Humoral) immune response,
3. External defense mechanisms,
4. Internal defense system

Unit II: Antigens and Immunogenicity: 3 hours
- Immunological properties of antigen,
- Factors affecting immunogenicity,
- Types of antigens, iso-antigens, epitomes.

Unit IV: Antibodies (Immunoglobulins) 4 hours
- Molecular structure,
- Classes,
- Types: Allotype, Isotype, Idiotype,
- Development: Mechanism of antibody formation and antibody diversity,
- Clonal selection theory, polyclonal and monoclonal, B and T cell and their maturation, monoclonal antibodies production and applications,
- Antibody Engineering:
  - Tagging,
Unit V: Compliment System: 2 hours
- Classical
- Alternative pathways

Unit VI: Interferon: Types and Working Mechanism: 2 hours

Unit VIII: Hypersensitivity Reactions: 3 hours
- Types of Hypersensitivity reactions,
- Concepts on tissue transplantation,
- Antigen processing and presentation-
  - Hypersensitivity 1, 2 and 4 responses-immune responses to parasites and humans.
  - T cells activation and tolerance. Immune response to infectious disease-viral, bacterial and protozoa.

Unit IX: Immune Tolerance and Autoimmunity: 3 hours
- Allergy immunotolerance,
- Autoimmunity,
- Autoimmune diseases, Rumatoid arthritis

Unit X: Immuno Deficiency Diseases: 3 hours
- HIV/AIDS,
- Cancers,
- Transplantation,
- Steroid therapy,

Unit XI: Vaccines and Immunization: 2 hours
Basic concept on vaccines and immunization.

Unit VII: Clinical Immunology: 6 hours
- Introduction,
- Antigen-antibody reactions and union of antigen and antibody,
- Types and characteristics of Ag-Ab reaction, Antigen determinants,
- Techniques of immunology:
  - Precipitation test,
  - Direct binding assay,
  - Immuno-diffusion test,
  - Immuno-electrophoresis,
  - Agglutination test,
  - Complement fixation test (CFT),
  - Radio immune assay (RIA),
  - Enzyme linked immunosorbent assay (ELISA),
  - Western blotting,
  - Fluorescene analysis,
  - Hybridoma technique,
  - Tuberculin test.

Unit IV: Major histocompatibility (MHC) 2 hours
- All graft, graft Vs host and mixed leucocytes response,
- Transplantation and immune response.
- T and B cell receptors.
Unit II: Handling of Lab Animals: 6 hours

- Basic concept on laboratory animals,
- Animal houses and its equipments,
- Feeding and breeding methods,
- Stock recording to handling of animals’
- Use of animals for diagnosis of human infections animal inoculation of diagnosis of various microbial infections and production of antibodies.

References:
1. Estimation of hormones and tumor markers.
2. Estimation of serum calcium and inorganic phosphorus.
3. Estimation of Fe, Ferritin, Iron binding capacity.
5. Estimation of serum Cortisol.
6. Estimation of VMA.
7. Estimation of T₃, T₄, TSH.
11. Quantitative estimation of protein
12. Determine urea in blood
13. Determine uric acid in blood.
14. Determination of Lipids profile by colorimetric method and chromatography method (TLC, GLC, HPLC and GC – MS),
15. Quantitative assay of amylase, ALT and AST in blood
16. To determine activities of blood enzymes of diagnostic importance (α-amylase, lactate dehydrogenase, alkaline phosphatase, aspartate and alanine amino transferase)
17. Perform renal function tests.
18. To perform liver function tests.

Epidemiology, Bio-statistics and Data management
B.Sc. Medical Biochemistry, Third Year, Sixth Semester

1. Data collection, particularly for the biochemical tests from a community using research methodological tools.
2. Investigation of biochemical parameters.
3. Manage the data (Biochemical Test) by using biostatistics tools.
4. Interpretation of the biochemical parameters.

Microbiology: Immunology
(B.Sc. Medical Biochemistry, Third Year, Sixth Semester)

1. Raising of the immunoglobulin in Rabbit
2. Purification and fragmentation of immunoglobulin,
3. Immunoprecipitation,
4. Immunoblotting,
5. Immunohisto / chemistry,
6. Affinity Chromatography
7. UV and visible light spectroscopy
8. Radio-immuno assay
9. Fractionation of rat liver homogenate into various sub-cellular fractions by centrifugation.
10. Serological test: perform ASO, CRP, VDRL, and Ra factor.
12. Demonstration Quantitative precipitin test.
15. Demonstration toxin neutralization test.
16. Demonstration of the production of antibodies from laboratory animals.
17. Perform ELISA, IHA. TPHA
B.Sc. Medical Biochemistry
Fourth Year
Seventh Semester
MBC 401.3 (Credit Hours 3)

Clinical Biochemistry V (Diagnostic)
B. Sc. Medical Biochemistry, Fourth Year, Seventh Semester

Course Objectives:
Upon successful completion of the course, students will be able to:
- Understand principles of clinical biochemistry.
- Listing the different biochemical assay used in clinical biochemistry lab.
- Performed important biochemical tests that are available in the context of Nepal.
- Identify the problems and conducting clinical biochemistry research.

Course Contents:
Unit I: Handling of Clinical Specimen for Biochemical Study: 4 hours
- Selection of sample collection area,
- Collection and transport of specimen.

Unit II: Analytical methods (diagnostic biochemistry), 6 hours
- Optimal methods for laboratory diagnosis of biochemical tests,
- Conventional and rapid method for biochemical tests,
- Non-traditional methods for biochemical,
- Principle of atomized methods used in clinical biochemistry, methods for recent advances in medical biochemistry.

Unit II: Systemically Analysis of Biochemical Parameters:
1. Acid-Base 4 hours
   - Investigation of pO₂, pCO₂, pH,
   - Metabolic acidosis, respiratory acidosis,
   - Respiratory alkalosis,
   - Oxygen content, oxygen saturation, pKa,
2. Renal function test 4 hours
   - Principle, procedures and interpretations, creatinine clearance tests,
3. Liver function test 4 hours
   - Principle, procedures and interpretations
4. Cardiac enzyme test 4 hours
   - Principle, procedures and interpretations
5. Pancreas 4 hours
   - Biochemical tests on Pancreas function tests;
   - Biochemical tests for steatorrhea
   - Gastric juice;
6. CSF and Body fluid 4 hours
7. Minerals and Electrolyte test 4 hours
   - Calcium and Phosphorus Sodium and Potassium, Iron, Mg
8. Biochemical analysis of Hormone 6 hours
   - Glucocorticoid and mineralocorticod,
   - Steroid Hormone- adrenal steroids androgens, estrogens, progesterone; other male and female reproductive hormones
   - Thyroid Hormone: T3, T4, TSH,
   - βHCG.
9. Agents Causing Cancer (Tumor Marker). 4 hours
BDM 402.3 (Credit hours 3)

Biostatistics and Data Management
(B.Sc. Medical Biochemistry, Fourth Year, Seventh Semester)

Course Objectives:
Upon successful completion of the course, students will be able to:
- Use statistical tools in bio-medical research.
- Manage and present the data using various statistical tools.
- Furnish the basic techniques on the use of computer and statistical programs for data analysis.

Course Contents:
Unit I: Introduction to Bio-statistics: 3 hours
- Definition of Bio-statistics,
- Role of Statistics in clinical biochemistry,
- Sample and population,
- Types of data, sources of data, types of variable, tools of measurement in statistics (Rate, Ratio, and Proportion), types of measurements,
- Limitation and misinterpretation of statistics.

Unit II: Data, Diagrams and Graphs: 5 hours
- General concept of Diagrams, graphs, and tables,
- Ordered array,
- Stem and Leaf display,
- Frequency distribution,
- Cumulative distribution,
- Relative frequency and
- Percentage distribution,
- Summary table,
- Contingency table,
- Diagrams and Graphs
  - Bar diagrams,
  - Pie chart,
  - Pictogram,
  - Cartogram,
  - Histogram,
  - Frequency polygon and
  - Cumulative frequency curve

Unit III: Describing Numerical Data: 6 hours
- Measures of central tendency
  - Mean,
  - Median,
  - Mode,
  - Geometric Mean,
- The shape (Skewness)
- Measures of variation
  - Range,
  - IQR,
  - Standard Deviation,
  - Coefficient of Variation,
• The five number summary,
• Box-Whisker Plot

Unit IV: Basic Probability Concepts: 7 hours
• Introduction,
• Terms used in probability,
• Views of probability (Subjective and Objective Probability),
• Laws of probability (Additional Law and Multiplicative Law),
• Conditional probability,
• Baye’s Theorem,
• Screening test,
• Sensitivity and specificity,
• Predictive value positive and negative.

Unit V: Probability Distribution: 8 hours
• Discrete probability distribution,
• Binomial distribution,
• Poisson distribution,
• Continuous probability distribution,
• Normal distribution.

Unit VI: Sampling: 4 hours
• Introduction-
  o Population,
  o Census vs. sample,
  o Reasons for sampling,
• Sampling unit,
• Sampling frame,
• Sampling fraction,
• Probability and non probability sampling,
• Parameters and statistics,
• Determination of minimum sample size (Mean and proportion),
• Methods of probability and non probability sampling,
  o Simple random sampling,
  o Stratified sampling,
  o Systematic sampling,
  o Cluster sampling,
  o Multistage sampling,
  o Purposive sampling,
  o Snowball sampling,
  o Quota sampling.

Unit VII: Sampling Distribution and Estimation: 4 hours
• The concept of sampling distribution,
• Standard error of mean and proportion,
• Precision,
• Point and interval estimation,
• The central limit theorem,
• Confidence interval estimation for the mean,
• Confidence interval estimation for the proportion.

Unit VIII: Hypothesis testing: 11 hours
• Types of hypothesis,
• Level of significance,
• Regions of rejection and non rejections,
• Errors in hypothesis testing,
• One tailed tests:
  o Z-test of hypothesis for the mean and for the proportion,
  o t-test of hypothesis for the mean,
• Comparing two samples:
  o t-test for difference between two means,
  o Z test for difference between two means,
  o Paired sample t-test,
  o The p-value approach,
  o A connection between confidence interval and hypothesis testing,
• Chi-square test:
  o Tests of Independence,
  o Yates's correction,
• Analysis of variance (ANOVA) test.
(Note: All examples are from health related field and computer based)

References:
2. Gupta SC. Fundamental of Statistics; Himalayan Publisher.
BIN 403.3 (Credit hours 3)

Bioinformatics
(B. Sc. Medical Biochemistry, Fourth Year, Seventh Semester)

Course Objectives:
Upon successful completion of the course, students will be able to:
- Understand general view of computer architecture, its operation and application and basic bioinformatics.
- Understand the basic computing and electronic resources of information and the techniques for retrieval of electronic resources available in the net for research purposes).
- Understand basics concept of Proteomics, Genomics, Phylogenetic tree.

Course Contents:
Unit I: Basic Introductory Computing: 10 hours
Importance and advantages of computer application in health research,
Overview of statistical software programs available for data analysis process,
MS-Windows program
- Working with Windows (My Computer, Recycle Bin, Desktop, Icons and Windows Explorer, Working with File and Folder
- Word processing (MS-Word) , MS-Excel, Presentation (MS-Power Point) Use of computer software and running
- Operation system in computer software
- Electronic resource searching, sending, cataloguing
Database Management:MS-Access, Epi-Info (2000) and SPSS
- introduction of other data management software.

Unit II: Introductory Bio-informatics: 4 hours
- The scope of bio-informatics
- Bio-informatics and interest
- Bioinformatics in the Pharmaceutical industry, Pharma informatics resources.
- Bio-informatics approach towards laboratory works
- Useful bio-informatics sites on the web.
  (Gene bank, free medical journal search, Pub Med, Hinari, PERI etc.)

Unit III: Genome Organization and Evolution: 10 hours
- Genomics and Proteomics
- Genomes of Prokaryotes, eukaryotes and human
- SNPs
- Genetic diversity in anthouropology
- Evolution of genomes

Unit IV: Archives and Information Retrieval: 8 hours
- The archives
- Gateways to archives
  o ENTREZ
  o SRS
  o PIR
  o ExPASy
  o Ensembl

Unit V: Alignment and Phylogenic Tree: 8 hours
• Introduction
• Dot plots and sequence alignments
• Measures of sequence similarity
• Computing the alignment of two sequences
• Significance of alignments
• Phylogeny
• Phylogenetic trees

Unit VI: Protein Structure and Drug Discovery: 8 hours
• Protein stability and folding
• Super position of structures
• DALI
• Protein structure prediction and modeling
• Prediction of protein function
• Drug discovery and development

References:
5. EPI- Info, EPI- Info 2000 manual, CDC, USA.
MBL 404-3 (Credit hours 3)

Management of Clinical Biochemistry Lab
B. Sc. Medical Biochemistry, Fourth Year, Seventh Semester

Course Objectives:
Upon successful completion of the course, students will be able to:
- Perform managerial work, supervision of subordinates, and preparation of periodic charts and maintain inventory.
- Perform hands on testing of the samples received during absence of the junior colleagues.
- Plan for logistic supply, costs of the tests and benefits to the customers and agency.
- Coordinate with the small-scale laboratories for sample collection, storage, transportation and providing results of the tests back.
- Coordinate with the physicians for appropriate samples and expedition of lab results back to the concerned parties.

Course Contents:
Unit I: Introduction: 3 hours
- Scope and importance of laboratory management,
- Class of management.

Unit II: Laboratory Management: 7 hours
- Human resources,
- Logistics and supply,
- Test performance,
- Data Management,
- Resource tapping,
- Instruments,
- Water and Sources of light and electricity,
- Room, table and benches.

Unit II: Laboratory Organization: 8 hours
- SOP,
- SSP,
- GLP,
- Counseling,
- Quality control biochemistry laboratory,
- Laboratory safety.

Unit II: Instruments Used in Laboratory: 8 hours
- Calibration,
- Quality control.

Unit IV: Rules and Regulation in the Laboratory: 6 hours
- Role and responsibilities of different personals in Laboratory (TOR)
- Professional ethics.

Unit V: Laboratory Quality Control Assessment: 10 hours
- Internal quality control and
- External quality control
Unit VI: Laboratory Waste Disposal System: 6 hours
- National and International Guidelines.
SEM 405.1 (Credit hour-1)

Clinical Biochemistry
B. Sc. Medical Biochemistry: Fourth Year, Seventh Semester

Instructional hours: 45

Course Objectives:
Upon successful completion of the course, students will be able to:
- Make familiar with literature review, presentation and seminar on clinical biochemistry field.

Course Contents:
Laboratory work data can be presented in the seminar.
Laboratory Works

Management of Clinical Biochemistry Laboratory
B. Sc. Medical Biochemistry, Fourth Year, Seventh Semester

Hospital based biochemical system wise analysis (interpretation and correlation, consultation with physician)
1. Perform managerial work, supervision of subordinates, and preparation of periodic charts and maintain inventory.
2. Perform hands on testing of the samples received during absence of the junior colleagues.
3. Plan for logistic supply, costs of the tests and benefits to the custumers and agency.
4. Coordinate with the small-scale laboratories for sample collection, storage.
5. Transportation and providing results of the tests back.
6. Coordinate with the physicians for appropriate samples and expedition of lab results back to the concerned parties.
7. Assessment internal quality control and external quality control: Quality control on laboratory investigation:
   a. SOP
   b. SSP
   c. GLP.
8. Furnish the basic techniques on the use of computer and statistical programs for data analysis
9. Identify the problems and conducting health research following research methodology,
10. Collect appropriate data analyze available data,
11. Write a report,
12. Prepare a research proposal.

Biostatics and Bioinformatics
B.Sc. Medical Biochemistry, Third Year, Seventh Semester

1. Handling of the computer.
2. Use statistical tools in bio-medical research.
3. Management and presentation of the data.
4. Applying various techniques for retrieval of electronic resources available in the net for research purposes. (Gene bank, Pubmed, Hinari, PERI ).
B. Sc. Medical Biochemistry
Fourth Year
Eight Semesters
DIS 406.6 (Credit hours 6)

Thesis / Dissertation
B. Sc. Medical Biochemistry, Fourth Year, Eighth Semester

Course Objectives:
This course is designed to provide students the knowledge and practice of public health research activity, to enable them to carry out researches and solve research related problems and to help them in writing thesis and defend their work. Upon successful completion of the course, the students shall be able to:

- Search relevant scientific literature
- Develop a research proposal
- Employ appropriate data collection techniques and tools
- Manage collected data
- Analyze data with appropriate statistical techniques
- Write thesis
- Defend the findings

Proposal Development:
At the beginning of fourth year (Seventh Semester), students in a group of five in consultation with designated faculties and extensive literature survey will develop research proposal during the initial 3 months period.

Data Collection/ Thesis Writing
Students will carry out data collection, data management, data analysis, and thesis writing during the remaining period (Seventh and Eight Semester).

The Dissertation Should Have Following Format:
1. Title
2. Introduction
3. Materials and Methods
4. Results
5. Discussion
6. Conclusion
7. Recommendation
8. References
9. Appendix

Evaluation:
Internal: 50% weight
Thesis Defense and Viva: 50% weight
INT 407.6 (Credit hours 6)

Hospital Internship Training
B. Sc. Medical Biochemistry, Fourth Year, Eighth Semester

Course Objectives:
Students will be exposed to professional work environment to acquire the knowledge, independent working capacity and leadership so that at the end of the course they will be able to manage the laboratory and research work with full responsibility and reliability.

Internship Training Guide Line:
1. Internship will be conducted in an institute under the supervision of supervisor/s accredited/recognized/registered by concerned professional councils.

2. Three to six months Internship should be completed within the last semester and it is as a partial fulfillment of the B. Sc Medical Biochemistry degree.

3. Semi residential Internship will be conducted in subject related areas in the hospital. The students have to work on a rotational basis (as per roaster set by the Supervisor) without any public holiday.

4. During the Internship, students should record his/her work and submit to the supervisor and department. A report of Internship work should be submitted to the department upon completion of the work certified by the concerned supervisor of the institute/hospital/factory.

5. Internship work will be evaluated as per Pokhara University rules and regulations.

Evaluation:
Hospital (Internal): 50% weight
Presentation: 50% weight
SEM 408.1 (Credit hour-1)

Clinical Biochemistry
B. Sc. Medical Biochemistry: Fourth Year, Eighth Semester

Instructional hours: 45

Course Objectives:
Upon successful completion of the course, students will be able to make familiar with seminar on clinical biochemistry field.

Course Contents:
A Thesis work can be presented in the seminar.