IUSOM

Curriculum

For

Pre-Medical Program

2013

International University School of Medicine (IUSOM)

Kaya Mofi # 1-A
P.O. Box # 59
Kralendijk, Bonaire
Dutch Caribbean (Formerly Netherlands Antilles)
Tel.: (599) 717 – 6792
Fax: (599) 717 – 8385
E.-Mail: info@internationaluniversity-schoolofmedicine.org
http://www.InternationalUniversity-SchoolOfMedicine.org

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Preface

This document presents a complete curriculum for the Pre-Medical (PreMed) program to be offered at the Bonaire-Campus (BO) of the International University School of Medicine (IUSOM) in Dutch Caribbean (Formerly Netherlands Antilles (NA)) as well to be offered at Worldwide IUSOM Branch Campuses located at Barranquilla (Colombia), México City (México), Sialkot (Pakistan), New Delhi (India), and Chennai (India), which is the result of several years' careful thinking, hard work, expert advices and suggestions of medical professionals and educationalists at the health sciences faculties and schools as well as at both academic and non-academic hospitals all located in USA, Canada, and EU including The Netherlands and Dutch Caribbean.

After brief introduction to PreMed curriculum in the Section 1 of this document, grading and examining system, examining format, US-, Canada-, and The Netherlands-tear system, attendance requirements, withdraw policy, and misconduct policy at IUSOM are cited in Sections 2 – 7. Section 8 includes an overview of the courses for PreMed program. Courses to be followed during the four semesters of this curriculum covering Premed-Medical Sciences are detailed in Sections 9 – 12.

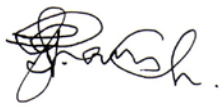
Each subsection covering a course is further divided into seven subsections, namely, purpose, goal, objectives, prerequisites, format, textbooks both required and recommended, and detailed description of the subject matter.

In brief, in order to complete a Pre-Medical program at IUSOM, a prospective medical student is required to complete in total 2,400 lecture/lab hours covering 160 credit hours at Bonaire-Campus.

This extensive curriculum has been constructed not only to enable students to follow successfully a PreMed program for eventual enrolment in the Doctor of Medicine (M.D.) degree program at IUSOM but also to prepare their strong foundations to eventually pass all steps of USMLE and / or similar licensing examinations held in Canada and EU including The Netherlands depending upon their choice of country where they wish to practice a medical profession.

Finally, this document is open to constructive criticism and comments from prospective students, academic staff members, potential competitors and alliances, medical educational institutions, governmental and non-governmental organizations and any other such associations and societies, and it shall be time to time modified accordingly.

Bonaire, Dutch Caribbean (Formerly Netherlands Antilles), September 2, 2013



Prof. Dr. Ghulam G. Choudhry, Ph.D., D.Sc.
President, International University School of Medicine (IUSOM) Foundation

Summary

In order to pursue Pre-Medical (PreMed) studies, at the International University School of Medicine (IUSOM) in Bonaire, Dutch Caribbean (Formerly Netherlands Antilles) as well at Worldwide IUSOM Branch Campuses located at Barranquilla (Colombia), México City (México), Sialkot (Pakistan), New Delhi (India), and Chennai (India), the students are required to successfully complete all PreMed courses at IUSOM-Bonaire Campus during four semesters, each such semester consisting of four months. Thereafter, the students are allowed to enroll in the Doctor of Medicine (M.D.) degree program at IUSOM.

During this PreMed education program at IUSOM, the students are provided solid foundations for attending M.D. degree program as well as to pass all steps of USMLE and / or similar exams, depending upon their final destination of medical practice after acquiring their M.D. degrees.

An overview of PreMed Curriculum to be followed at IUSOM is recorded in TABLE 1, given below.

TABLE 1. Summary of the Pre-Medical (PreMed) Courses Required to be Completed Prior to Enrolling for the Doctor of Medicine (M.D.) Degree Program at IUSOM.

SEMESTER #	COURSE CODE: NAME	LECTURE /LAB HOURS	CREDIT HOURS
First Semester	IUSOM-BO-PreMed-01-01: General Chemistry - I	150 hrs	10 hrs
	IUSOM-BO-PreMed-01-02: Physics - I	150 hrs	10 hrs
	IUSOM-BO-PreMed-01-03: Biology - I	150 hrs	10 hrs
	IUSOM-BO-PreMed-01-04: Calculus	150 hrs	10 hrs
	Total	**600 hrs**	**40 hrs**
Second Semester	IUSOM-BO-PreMed-02-01: General Chemistry - II	150 hrs	10 hrs
	IUSOM-BO-PreMed-02-02: Physics - II	150 hrs	10 hrs
	IUSOM-BO-PreMed-02-03: Biology - II	150 hrs	10 hrs
	IUSOM-BO-PreMed-02-04: Organic Chemistry – I	150 hrs	10 hrs
	Total	**600 hrs**	**40 hrs**
Third Semester	IUSOM-BO-PreMed-03-01: General Chemistry - III	150 hrs	10 hrs
	IUSOM-BO-PreMed-03-02: Physics - III	150 hrs	10 hrs
	IUSOM-BO-PreMed-03-03: Biology - III	150 hrs	10 hrs
	IUSOM-BO-PreMed-03-04: Organic Chemistry - II	150 hrs	10 hrs
	Total	**600 hrs**	**40 hrs**
Fourth Semester	IUSOM-BO-PreMed-04-01: English: On Medicine	150 hrs	10 hrs
	IUSOM-BO-PreMed-04-02: Introduction to Anatomy	120 hrs	8 hrs
	IUSOM-BO-PreMed-04-03: Introduction to Molecular Cell Biology	120 hrs	8 hrs
	IUSOM-BO-PreMed-04-04: Organic Chemistry - III	210 hrs	14 hrs
	Total	**600 hrs**	**40 hrs**
Entire PreMed Program	**Grand Total**	**2,400 hrs**	**160 hrs**

1. Introduction to Pre-Medical (PreMed) Curriculum

At International University School of Medicine (IUSOM), Bonaire, Dutch Caribbean (Formerly Netherlands Antilles) as well at Worldwide IUSOM Branch Campuses located at Barranquilla (Colombia), México City (México), Sialkot (Pakistan), New Delhi (India), and Chennai (India), a total of four semesters' class room course work covering Pre-Medical (PreMed) Sciences is required enabling the students to pursue Doctor of Medicine (M.D.) degree program at IUSOM. Each such course is offered at all IUSOM Campuses. Each semester for PreMed consists of four months.

At IUSOM, the medium of instructions for entire PreMed curriculum is English.

After successful completion of PreMed program, the students are allowed to enroll in M.D. degree program at IUSOM.

2. Grading and Examining System

At IUSOM, minimum passing marks are 70%, i.e., 69% marks are considered as failing marks. Letter grades, namely, A, B, and C for each subject are awarded to the PreMed students, whose overall marks in a semester amount to the range of 90-100%, 80-89%, 70-79%, respectively.

During each PreMed semester, IUSOM holds two EXAMs (one Midterm EXAM and the other Final EXAM), with a weight of 45% marks for each EXAM, for each subject, total weight being 90% of both EXAMs. The remaining 10% marks are awarded basing upon the daily assignments completed by the students and their daily attendances in the class.

3. Examining Formats

In accordance to USMLE, all examining formats shall be multiple choice questions. A non-cumulative multiple-choice written examination (50 questions) will be given at the scheduled periods. The examination shall not be constructed to assess everything a student knows or should know, but rather, it shall attempt to target the essentials.

4. US-, Canada-, and The Netherlands-Tear Systems

Depending upon where the students wish to practice medicine, IUSOM in Bonaire provides not only PreMed as well as M.D. education for eventual award of M.D. degrees but it provides also training to US-Tear, Canada-Tear, and The Netherlands-Tear system students, for all levels of United States Medical Licensing Examination (USMLE), Medical Council of Canada Evaluating Examination (MCCEE), and The Netherlands Medical Licensing Examination, respectively.

5. Attendance Requirements

It is the policy of IUSOM that 90% of attendance for a subject is must. Otherwise, such course is required to be repeated in the subsequent semester, regardless of the fact that a student might have done fairly good in the all EXAMs.

6. Withdrawing Policy

A PreMed-student may voluntarily withdraw from any course at any time. For rules and regulations, please consult the **Handbook of Rules and Regulation for IUSOM Students**.

7. Misconduct

Student misconduct in any fashion is strictly forbidden at IUSOM. Please consult the **Handbook of Rules and Regulation for IUSOM Students**. Its policies shall be strictly enforced.

8. Overview of the Courses for PreMed Program

Details of the curriculum of the PreMed Sciences course work for all four semesters (duration of each semester being four months), offered at IUSOM-Bonaire campus, is described in the next four sections (see Sections 9-12).

A summary of the Pre-Medical Sciences curriculum is documented in TABLE 1 given on page 4.

9. Courses for the First Semester of PreMed (IUSOM—BO—PreMed—01—00)

At IUSOM, the courses required for the first semester of PreMed program (IUSOM—BO—PreMed—01—00) are mentioned below in full details **(Total Lecture/Lab hrs: 600 & Total Credits: 40)**.

9.1 General Chemistry - I (IUSOM—BO—PreMed—01—01)

General Chemistry – I course required during the first semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—01—01) is cited below **(Lecture/Lab hrs: 150 & Credits: 10)**:

9.1.1 Purpose

This General Chemistry - I Course has been designed to teach chemistry to those students who have career interests not in chemistry but in biology, medicine and other life sciences, the main purpose being to provide an opportunity, which is only one, to such students, to learn some practical applications of chemistry.

9.1.2 Goal

After introducing to fundamental concepts from the most elementary ideas, the students shall be provided solid basis in principals and modern applications of chemistry in the context of high quality medicine and its general practice, especially not ignoring the role of molecular biology, which is of utmost importance.

9.1.3 Objectives

A student with ultimate interest in medicine, after completing this course, is anticipated to be able to understand very clearly the concept of: 1. Atoms and molecules. 2. States of matter and its properties. 3. Chemistry of the elements. 4. Chemical reactions in various phases. 5. Thermodynamics and equilibrium. 6. Stoichiochemistry. 7. Chemical bonding.

9.1.4 Prerequisites

Introductory Biology, Chemistry, Physics and Mathematics taken for the International Baccalaureate (IB) (Exam held by International Baccalaureate Organization (IBO)), VWO (in The Netherlands and Dutch Caribbean (Formerly Netherlands Antilles)), Provincial

High School Exams (in Canada), and State High School Exams (in USA) diplomas and/or equivalent diplomas are prerequisites.

9.1.5 Format

The course materials in the form of lectures/discussions shall be presented and tested in a traditional format using modern audiovisual equipments, like LCD projectors, MS PowerPoint presentations, and overhead transparencies.

9.1.6 Textbooks for General Chemistry - I

The following textbooks and support materials are required / recommended for this General Chemistry - I course:

Required:

1. GENERAL CHEMISTRY: PRINCIPLES AND MODERN APPLICATIONS (2006) by Ralph H. Petrucci, William S. Harwood, and F.G. Herring, Publishers: Prentice Hall, 9th Edition, ISBN-10: 0131493302 or ISBN-13: 978-0131493308.

Recommended:

2. GENERAL CHEMISTRY (2004) by John W. Hill, Ralph H. Petrucci, Terry W. McCreary, and Scott S. Perry, Publishers: Prentice Hall, 4th Edition, ISBN-10: 0131402838 or ISBN-13: 978-0131402836.

9.1.7 Description of the General Chemistry - I Course Contents

The subject matter to be covered in the General Chemistry - I course (IUSOM—BO—PreMed—01—01) is as follows:

MATTER: ITS PROPERTIES AND MEASUREMENT (the scope of chemistry, the scientific method, properties of matter, classification of matter, measurement of matter: SI (metric) units, density and percentage composition: their use in problem solving, uncertainties in scientific measurements, significant figures, and focus: the scientific method at work: polywater); ATOMS AND THE ATOMIC THEORY (early chemical discoveries and the atomic theory, electrons and other discoveries in atomic physics, the nuclear atom, chemical elements, atomic masses, introduction to the periodic table, the concept of the mole and the Avogadro constant, using the mole concept in calculations, and focus: occurrence and the abundance of the elements); CHEMICAL COMPOUNDS (types of chemical compounds and their formulas; mole concept and chemical compounds, composition of chemical compounds, oxidation state: a useful tool in describing chemical compounds, naming compounds: organic and inorganic, names and formulae of inorganic compounds, names and formulae of organic compounds, and focus: mass spectrometry—determining molecular formulae); CHEMICAL REACTIONS (chemical reactions and chemical equations, chemical equations and stoichiometry, chemical reactions in solution phases, determining the limiting reactant, other practical matters in reaction stoichiometry, and focus: industrial chemistry); INTRODUCTION TO REACTIONS IN AQUATIC SOLUTION PHASE (nature of aqueous solutions, precipitation reactions, acid—base reactions, oxidation—reduction: some general principles, balancing oxidation—reduction equations, oxidizing and reducing agents, stoichiometry of reactions in aqueous solutions: titrations, and focus: water treatment); THERMOCHEMISTRY (some terminologies, heat,

heat of reactions and calorimetry, work, first law of thermodynamics, heats of reactions: $\underline{\wedge}$ *U* and $\underline{\wedge}$ *H*, Hess's law: indirect determination of $\underline{\wedge}$ *H*, standard enthalpies of formation, fuels as sources of energy, and focus: fats, carbohydrates, energy storage); ELECTRONS IN ATOMS (electromagnetic radiations, atomic spectra, quantum theory, the Bohr atom, two ideas leading to a new quantum mechanics, wave mechanics, quantum numbers and electron orbitals, interpreting and representing orbitals of the hydrogen atom, electron spin: a fourth quantum number, multielectron atoms, electron configurations, electron configurations and the periodic table, and focus: helium—neon lasers); PERIODIC TABLE AND SOME ATOMIC PROPERTIES (classifying the elements: periodic law and periodic table, metals and nonmetals and their ions, sizes of atoms and ions, ionization energy, electron affinity, magnetic properties, periodic properties of the elements, and focus: periodic law and mercury); CHEMICAL BONDING: BASIC CONCEPTS (Lewis theory: an overview, covalent bonding, polar covalent bonds, writing Lewis structures, resonance, exceptions to the octet rule, shapes of molecules, bond order and bond lengths, bond energies, and focus: polymers—macromolecular substances); and CHEMICAL BONDING: ADDITOIONAL ASPECTS (what a bonding theory should do, introduction to valence—bond method, hybridization of atomic orbitals, multiple covalent bonds, molecular orbital theory, delocalized electrons: bonding in benzene molecule, bonding in metals, and focus: photoelectron spectroscopy). **(Lecture/Lab hrs: 150 & Credits: 10)**

9.2 Physics - I (IUSOM—BO—PreMed—01—02)

Physics - I course required during the first semester of PreMed at IUSOM (Code: IUSOM—BO—PreMed—01—02) is cited below **(Lecture/Lab hrs: 150 & Credits: 10):**

9.2.1 Purpose

This Physics - I course has been designed to teach mechanics and waves/acoustics to those students who have career interests not in physics but in biology, medicine and other life sciences, the main purpose being to provide an opportunity, which is only one, to such students, to learn some practical applications of such branches of physics.

9.2.2 Goal

The course goal is to provide students, through lecture presentations, a manageable synopsis of the fundamental principals of calculus-based physics covering mechanics and waves/acoustics and how to apply them to life sciences including medicine.

9.2.3 Objectives

The objectives of this Physics - I course are to assist students to: 1. Develop conceptual understanding of two branches of physics, namely, mechanics and waves/acoustics. 2. Build strong problems-solving skills concerning such fields of physics, when applied them to medicine.

9.2.4 Prerequisites

Introductory Biology, Chemistry, Physics and Mathematics taken for the International Baccalaureate (IB) (Exam held by International Baccalaureate Organization (IBO)), VWO (in The Netherlands and Dutch Caribbean (Formerly Netherlands Antilles)), Provincial

High School Exams (in Canada), and State High School Exams (in USA) diplomas and/or equivalent diplomas are prerequisites.

9.2.5 Format

The course materials in the form of lectures/discussions shall be presented and tested in a traditional format using modern audiovisual equipments, like LCD projectors, MS PowerPoint presentations, overhead transparencies, CDs and DVDs.

9.2.6 Textbooks for Physics – I

The following textbooks and support materials are required / recommended for this Physics - I course:

Required:

1. SEARS AND ZEMANSKY'S UNIVERSITY PHYSICS: WITH MODERN PHYSICS (2007) by Hugh D. Young and Roger A. Freedman, Publishers: Pearson, Addison, and Wesley, 12th Edition, ISBN-10: 0321501314 or ISBN-13: 978-0321501318.

Recommended:

2. PHYSICS (2009) by John D. Cutnell and Kenneth W. Johnson, Publishers: John Wiley & Sons, 8th Edition, ISBN-10: 0470223553 or ISBN-13: 978-0470223550.

9.2.7 Description of the Physics - I Course Contents

The subject matter to be covered in the Physics - I course (IUSOM—BO—PreMed—01—02) is as follows:

UNITS, PHYSICAL QUANTITIES, AND VECTORS (nature of physics, solving physics problems, standards and units, units consistency and conversions, uncertainties and significant figures, estimates and orders of magnitude, vectors and vector addition, components of vectors, unit vectors, and products of vectors); MOTION ALONG A STRAIGHT LINE (displacement, time, average velocity, instantaneous velocity, average and instantaneous acceleration, motion with constant acceleration, freely falling bodies, and velocity and position by integration); MOTION IN TWO OR THREE DIMENSIONS (position and velocity vectors, acceleration vector, motion in a circle, and relative velocity); NEWTON'S LAWS OF MOTION (force and interactions, Newton's first, second and third laws, mass and weight, and free-body diagram); APPLICATIONS OF NEWTON'S LAWS (using Newton's first law: particles in equilibrium, using Newton's second law: dynamics of particles, frictional forces, dynamics of circular motion, and fundamental forces of motion); WORK AND KINETIC ENERGY (work, work and kinetic energy, work and energy with varying forces, and power); POTENTIAL ENERGY AND ENERGY CONSERVATION (gravitational potential energy, elastic potential energy, conservative and nonconservative forces, forces and potential energy, and energy diagrams); MOMENTUM, IMPULSE, AND COLLISIONS (momentum and impulse, conservation of momentum, inelastic collisions, elastic collisions, center of mass, and rocket propulsion); ROTATION OF RIGID BODIES (angular velocity and acceleration, rotation with constant angular motion, relating linear angular kinematics, energy in a rotational motion, parallel-axis theorem, and moment of inertia calculations); DYNAMICS OF ROTATIONAL MOTION (torque, torque and angular acceleration for a rigid body, rigid-body rotation

about a moving axis, work and power in rotational motion, angular momentum, conservation of angular momentum, and gyroscope and precession); EQUILIBRIUM AND ELASTICITY (conditions for equilibrium, center of gravity, solving rigid-body equilibrium problems, stress, strain, and elastic moduli, and elasticity and plasticity); GRAVITATION (Newton's law of gravitation, weight, gravitational potential energy, motion of satellites, Kepler's laws and motion of planets, spherical mass distribution, apparent weight and earth's rotation, and black holes); PERIODIC MOTION (oscillations, simple harmonic motions: energy in them and their application, simple pendulum, damped oscillations, and forced oscillations and resonance); FLUID MECHANICS (density, pressure in fluid, buoyancy, fluid flow, Bernoulli's equation, and viscosity and turbulence); MECHANICAL WAVES (types, periodic waves, mathematical description of a wave, speed of a transverse wave, energy in a wave motion, wave interference boundary conditions, and superposition, standing waves on a string, and normal modes of string); and SOUND AND HEARING (sound waves and their speed, sound intensity, standing sound waves and normal modes, resonance, interference of waves, beats, Doppler's effect, and Stock waves) . **(Lecture/Lab hrs: 150 & Credits: 10)**

9.3 Biology - I (IUSOM—BO—PreMed—01—03)

Biology course required during the first semester of PreMed at IUSOM (Code: IUSOM—BO—PreMed—01—03) is cited below **(Lecture/Lab hrs: 150 & Credits: 10)**:

9.3.1 Purpose

The purpose of this course is to familiarize the medical students with the basic concepts that comprise the science of living organisms. This is an overview of the different branches of biological sciences. This course will provide the introductory foundation for further studies encountered in subsequent semesters of both Premed and M.D. programs.

9.3.2 Goal

The course goal is to provide students a solid foundation in biological sciences.

9.3.3 Objectives

The objectives of this Biology – I course are that upon its completion, a student should be able to: 1. Understand how scientists work. 2. Know the characteristics of life. 3. Understand how life perpetuates and adapts. 4. Know how the structure of living organisms is organized. 5 Have a basic knowledge of animal and plant physiology. 6. Understand how life interacts with its environment. 7. Understand basic biochemical processes of living organisms.

9.3.4 Prerequisites

Introductory Biology, Chemistry, Physics and Mathematics taken for the International Baccalaureate (IB) (Exam held by International Baccalaureate Organization (IBO)), VWO (in The Netherlands and Dutch Caribbean (Formerly Netherlands Antilles)), Provincial High School Exams (in Canada), and State High School Exams (in USA) diplomas and/or equivalent diplomas are prerequisites.

9.3.5 Format

A traditional lecture/discussion format with the aid of MS PowerPoint slide presentations will be used to present course materials. Additionally, students will be provided with the opportunity to participate in regularly scheduled laboratory sessions designed to enhance student understanding of biological phenomena.

9.3.6 Textbooks for Biology - I

The following textbooks and support materials are required / recommended for this Biology - I course:

Required:

1. CAMBELL BIOLOGY (2011) by Jane B. Reece, Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Robert B. Jackson, Publishers: Pearson Education, 9th Edition, ISBN-10: 0321739752 or ISBN-13: 978-0321739759.

Recommended:

2. BIOLOGY: LIFE ON EARTH WITH PHYSIOLOGY (2010) by Gerard Audesirk, Teresa Audesirk, and Bruce E. Byers, Publishers: Benjamin Cummings, 9th Edition, ISBN-10: 0321598466 or ISBN-13: 978-0321598462.

9.3.7 Description of the Biology - I Course Contents

The subject matter to be covered in the Biology - I course (IUSOM—BO—PreMed—01—03) is as follows:
INTRODUCTION: EXPLORING LIFE; THE CHEMICAL CONTEXT OF LIFE; WATER AND FITNESS OF THE ENVIRONMENT; CARBON AND THE MOLECULAR DIVERSITY OF LIFE; THE STRUCTURE AND FUNCTION OF MACROMOLECULES; A TOUR OF THE CELL; MEMBRANE STRUCTURE AND FUNCTION; AN INTRODUCTION TO METABOLISM; CELLULAR RESPIRATION: HARVESTING CHEMICAL ENERGY; PHOTOSYNTHESIS; CELL COMMUNICATION; THE CELL CYCLE; MEIOSIS AND SEXUAL LIFE CYCLE; MENDEL AND THE GENE IDEA; INHERITANCE: ITS CHROMOSOMAL AND MOLECULAR BASIS; FROM GENE TO PROTEIN; THE GENETICS AND VIRUSES OF BACTERIA; EUKARYOTIC GENOMES: ORGANIZATION, REGULATION AND EVOLUTION; DNA TECHNOLOGY AND GENOMICS; and GENETIC BASIS OF DEVELOPMENT. **(Lecture/Lab hrs: 150 & Credits: 10)**

9.4 Calculus (IUSOM—BO—PreMed—01—04)

Calculus course required during the first semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—01—04) is cited below **(Lecture/Lab hrs: 150 & Credits: 10)**:

9.4.1 Purpose

This Math Course covering mainly calculus has been designed to teach calculus to those students who have career interest not in math but in biology, medicine and other life sciences, the main purpose being to provide an opportunity, which is only one, to such students, to learn some practical applications of calculus.

9.4.2 Goal

The main goal of this course is on the one hand to convey to the students a sense of the utility of calculus in the field of medicine including developing technical competence and to struggle to provide some appreciation for the intrinsic beauty of the subject on the other. After introducing to fundamental concepts from the most elementary ideas, the students shall be provided strong basis in principals and modern applications of calculus in the context of modeling of biological systems, which is of utmost importance in the field of medicine.

9.4.3 Objectives

A student with ultimate interest in medicine, after completing this course, is anticipated to be able to understand very clearly the concept of: 1. Numbers, inequalities, functions, and analytic geometry. 2. Limits and continuity. 3. Derivatives and applications. 4. Taylor polynomials. 5. Log, exp, and inverse trigonometric functions. 6. Integration, fundamental theorem of calculus substitution, trapezoidal and Simpson's rules. 7. Area between curves, techniques of integration. 8. Applications of integration to work, biology and probability. 9. First-order differential equations: separable, linear, direction fields, Euler's method, and applications. 10. Second-order differential equations and their applications. 11. Infinite series and power series. 12. Taylor expansions with remainder terms. 13. Polar coordinates. 14. Arc length, cylindrical and spherical coordinates, and curvature. 15. Normal binominals and tangent plane in 3-dimensional space. 16. Volumes and surface areas of rotation. 17. S/he should be able to apply this overwhelming knowledge of calculus without any doubt and misunderstanding in the safe and cautious practice of medicine with human beings and other living bodies.

9.4.4 Prerequisites

Introductory Biology, Chemistry, Physics and Mathematics taken for the International Baccalaureate (IB) (Exam held by International Baccalaureate Organization (IBO)), VWO (in The Netherlands and Dutch Caribbean (Formerly Netherlands Antilles)), Provincial High School Exams (in Canada), and State High School Exams (in USA) diplomas and/or equivalent diplomas are prerequisites.

9.4.5 Format

The course materials in the form of lecture/discussion shall be presented and tested in a somewhat traditional format using state-of-the-art and highly modern audio-visual technologies, namely, MS PowerPoint slide presentation program, Instructor's Resource CD-ROM (ISBN 05-343-9340-3), Transparencies by James Stewart: Single Variable (ISBN 05-343-9337-3), Transparencies by James Stewart: Multivariable (ISBN 05-343-9383-7), Brooks/Cole Assessment (BCA) Testing (ISBN 05-343-9335-7) and Text-Specific Videos (only) (ISBN 05-343-9325-X).

9.4.6 Textbooks for Calculus

The following textbooks and support materials are required / recommended for this Calculus course:

Required:

1. CALCULUS: EARLY TRANSCENDENTALS (2007) by James Stewart, Publishers: Brooks/Cole, 6th Edition, ISBN-10: 0495011665 or ISBN-13: 978-0495011668.

Recommended:

2. MODELING THE DYNAMICS OF LIFE: CALCULUS AND PROBABILITY (2004) by Frederick R. Adler, 2nd Edition, ISBN-10: 0534404863 or ISBN-13: 978-0534404864.

9.4.7 Description of the Calculus Course Contents

The subject matter to be covered in the Calculus course (IUSOM—BO—PreMed—01—04) is as follows:

A REVIEW OF CALCULUS (area problem, tangent problem, velocity, limit of a sequence, and sum of series); FUNCTIONS AND MODELS (four ways of representing a function, mathematical models: essentials functions, new functions from old functions, graphical calculators and computers, exponential functions, and inverse functions and logarithms); LIMITS AND DERIVATIVES (tangent and velocity problems, tangents, velocities, and other rates of change, derivatives, and derivatives as function); DIFFERENTIAL RULES (derivatives of polynomials and exponential functions, product and quotient rules, rates of the changes in natural and social sciences, derivatives of trigonometric functions, chain rule, implicit differentiation, higher derivatives, derivatives of logarithmic functions, and hyperbolic functions,); INTEGRALS (areas and distances, definite integral, fundamental theorem of calculus, indefinite integrals and the net change theorem, substitution rule, and logarithmic defined as integral); APPLICATIONS OF INTEGERATION (applications to work, biology, arc length, probability, areas between curves, volumes, and volumes by cylindrical shells); TECHNIQUES OF INTEGRATION (integration by parts, trigonometric integrals, trigonometric substitutions, integration of rational functions by partial functions, strategy for integration, integration using tables and computer algebra systems, approximate integration, and improper integrals); DIFFERENTIAL EQUATIONS (modeling with differential equations, direction fields and Euler's method, separable equations, exponential growth and decay, logarithmic equation, linear equations, and predator-prey system); PARAMETRIC EQUATIONS AND POLAR COORDINATES (curves defined by parametric equations, calculus with parametric curves, polar coordinates, area and lengths in polar coordinates, conic sections, and conic sections in polar coordinates); INFINITE SEQUENCES AND SERIES (sequences, series: alternating, power, binomial , Taylor's and Maclaurin, and applications of Taylor polynomials); VECTORS AND GEOMETRY OF SPACE (three-dimensional coordinates, vectors, dot product, cross product, equations of lines and planes, cylinders and quadratic surfaces, and cylindrical and spherical coordinates), VECTOR EQUATIONS (vector functions and space curves, derivatives and integrals of vector functions, arc length and curvature, and motion in space: velocity and acceleration); PARTIAL DERIVATIVES (functions of several variables, limits and continuity, partial derivatives, tangent plane and linear approximations, chain rule, directional derivatives and the gradient vector, maximum and minimum values, and Lagrange multipliers); VECTOR CALCULUS (vector fields, line integrals, fundamental theorem for line integrals, Green's theorem, curl and divergence, parametric surfaces and their areas, surface integrals, Stokes' theorem, and divergence theorem); and SECOND-ORDER DIFFERENTIAL EQUATIONS (second-order linear equations, nonhomogeneous

linear equations, applications of such equations, and series solutions). **(Lecture/Lab hrs: 150 & Credits: 10)**

10. Courses for the Second Semester of PreMed (IUSOM—BO—PreMed—02--00)

At IUSOM, the courses required for the second semester of PreMed program (IUSOM—BO—PreMed—02—00) are mentioned below in full details **(Total Lecture/Lab hrs: 600 & Total Credits: 40)**.

10.1 General Chemistry - II (IUSOM—BO—PreMed—02—01)

General Chemistry - II course required during the second semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—02—01) is cited below **(Lecture/Lab hrs: 150 & Credits: 10)**:

10.1.1 Purpose

This General Chemistry - II Course has been designed to continue to teach chemistry to those students who have career interests not in chemistry but in biology, medicine and other life sciences, the main purpose being to provide an opportunity, which is only one, to such students, to learn additional practical applications of chemistry.

10.1.2 Goal

After introducing to additional fundamental concepts from the most elementary ideas, the students shall be provided solid basis in additional principals and modern applications of chemistry in the context of high quality medicine and its general practice, especially not ignoring the role of molecular biology, which is of utmost importance.

10.1.3 Objectives

A student with ultimate interest in medicine, after completing this course, is anticipated to be able to understand very clearly the concept of: 1. Gas laws and related theories. 2. Atmospheric gases. 3. Intermolecular forces. 4. Vapor and osmotic pressures. 5. Colloidal solutions. 6. Rates and orders of chemical reactions. 7. Chemical equilibria. 8. Acids and bases theories. 9. Precipitations including partial ones.

10.1.4 Prerequisites

General Chemistry – I, Physics – I, Biology – I and Calculus taken during the first semester of PreMed program at IUSOM are prerequisites.

10.1.5 Format

The course materials in the form of lectures/discussions shall be presented and tested in a traditional format using modern audiovisual equipments, like LCD projectors, MS PowerPoint presentations, and overhead transparencies.

10.1.6 Textbooks for General Chemistry – II

The following textbooks and support materials are required / recommended for this Medical Biochemistry course:

Required:

1. GENERAL CHEMISTRY: PRINCIPLES AND MODERN APPLICATIONS (2006) by Ralph H. Petrucci, William S. Harwood, and F.G. Herring, Publishers: Prentice Hall, 9th Edition, ISBN-10: 0131493302 or ISBN-13: 978-0131493308.

Recommended:

2. GENERAL CHEMISTRY (2004) by John W. Hill, Ralph H. Petrucci, Terry W. McCreary, and Scott S. Perry, Publishers: Prentice Hall, 4th Edition, ISBN-10: 0131402838 or ISBN-13: 978-0131402836.

10.1.7 Description of the General Chemistry – II Course Contents

The subject matter to be covered in the General Chemistry – II course (IUSOM—BO—PreMed—02—01) is as follows:

GASES (properties of gases: gas pressure, simple gas laws, combining gas laws: ideal gas equation and general gas equation, applications of ideal gas equation, gases in chemical reactions, mixtures of gases, kinetic-molecular theory of gases, gas properties relating to the kinetic-molecular theory, nonideal (real) gases, and focus: chemistry of air-bag systems); ATMOSPHERIC GASES AND HYDROGEN (the atmosphere, nitrogen, oxygen, noble gases, oxides of carbon, hydrogen, and focus: the carbon cycle); LIQUIDS, SOLIDS, AND INTERMOLECULAR FORCES (intermolecular forces and some properties of liquids, vaporization of liquids: vapor pressure, some properties of solids, phase diagrams, van der Waals forces, hydrogen bonding, chemical bonds as intermolecular forces, crystal structures, energy changes in the formation of ionic crystals, and focus: liquid crystals); SOLUTOPNS AND THEIR PHYSICAL PROPERTIES (solutions: types and terminologies, solution concentration, intermolecular forces and solution forces, solution formation, solubilities of gases, vapor pressure of solutions, osmotic pressure, freezing-point depression and boiling-point elevation of nonelectrolyte solutions, solutions of electrolytes, colloidal mixtures, and focus: liquid crystals); CHEMICAL KINETICS (rate of a chemical reaction, measuring of reaction rates, effect of concentration on reaction rates: the rate low, zero-order reactions, first-order reactions, second-order reactions, reaction kinetics, theoretical models for chemical kinetics, effect of temperature on reaction rates, reaction mechanisms, catalysis, and focus: combustion and explosions); PRINCIPLES OF CHEMICAL EQUILIBRIUM (dynamic equilibrium, equilibrium constant expression, relationships involving equilibrium constants, significance of the magnitude of an equilibrium constant, reaction quotient , *Q*: predicting the direction of net change, altering equilibrium conditions: Le Chatlier's principle, equilibrium calculations: some illustrative examples, focus: the nitrogen cycle and the synthesis of nitrogen compounds); ACIDS AND BASES (Arrhenius theory, Bronsted-Lowery theory of acids and bases, self-ionization of water and the pH scale, strong acids and strong bases, weak acid and weak bases, polyprotic acids, ions as acids and bases, molecular structure and acid-base behavior, Lewis acids and bases, focus: acid rain); ADDITIONAL ASPECTS OF ACID-BASE EQUILIBRIA (common-ion effect on in acid-base equilibria, buffer solutions, acid-base indicators, neutralization reactions and titration curves, solutions of salts of polyprotic acids, acid-base equilibrium calculations, and focus: buffers in blood); and SOLUBILITY AND COMPLEX-ION EQUILIBRIA (solubility product constant (k_{sp}), relationship between solubility and k_{sp} ,common-ion effect in solubility equilibria, limitations of the k_{sp}

concept, criteria for precipitation and its completeness, fractional precipitation, solubility and pH, equilibria involving complex ions, qualitative cation analysis, and focus: shells, teeth, and fossils). **(Lecture/Lab hrs: 150 & Credits: 10)**

10.2 Physics – II (IUSOM—BO—PreMed—02—02)

Physics – II course required during the second semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—02—02) is cited below **(Lecture/Lab hrs: 150 & Credits: 10):**

10.2.1 Purpose

This Physics - II course has been designed to teach thermodynamics and electromagnetism to those students who have career interests not in physics but in biology, medicine and other life sciences, the main purpose being to provide an opportunity, which is only one, to such students, to learn some practical applications of such branches of physics.

10.2.2 Goal

The course goal is to provide students, through lecture presentations, a manageable synopsis of the fundamental principals of calculus-based physics covering thermodynamics and electromagnetism and how to apply them to life sciences including medicine.

10.2.3 Objectives

The objectives of this Physics – II course are to assist students to: 1. Develop conceptual understanding of two branches of physics, namely, thermodynamics and electromagnetism. 2. Build strong problems-solving skills concerning such fields of physics, when applied them to medicine.

10.2.4 Prerequisites

General Chemistry – I, Physics – I, Biology – I and Calculus taken during the first semester of PreMed program at IUSOM are prerequisites.

10.2.5 Format

The course materials in the form of lectures/discussions shall be presented and tested in a traditional format using modern audiovisual equipments, like LCD projectors, MS PowerPoint presentations, overhead transparencies, CDs and DVDs.

10.2.6 Textbooks for Physics – II

The following textbooks and support materials are required / recommended for this Physics – II course:

Required:

1. SEARS AND ZEMANSKY'S UNIVERSITY PHYSICS: WITH MODERN PHYSICS (2007) by Hugh D. Young and Roger A. Freedman, Publishers: Pearson, Addison, and Wesley, 12th Edition, ISBN-10: 0321501314 or ISBN-13: 978-0321501318.

Recommended:

2. PHYSICS (2009) by John D. Cutnell and Kenneth W. Johnson, Publishers: John Wiley & Sons, 8th Edition, ISBN-10: 0470223553 or ISBN-13: 978-0470223550.

10.2.7 Description of the Physics – II Course Contents

The subject matter to be covered in the Physics – II course (IUSOM—BO—PreMed—02—02) is as follows:

TEMPERATURE AND HEAT (temperature and heat, thermometers and temperature scales, gas thermometers and Kelvin scale, thermal expansion, quantity of heat, calorimetry and phase changes, and mechanisms of heat transfer); THERMAL PROPERTIES OF MATTER (equations of state, molecular properties of matter, kinetic-molecular model of an ideal gas, heat capacities, molecular speeds, and phases of matter); FIRST LAW OF THERMODYNAMICS (thermodynamic systems, work done during volume changes, paths between thermodynamic states, internal energy and first law of thermodynamics, types of thermodynamic processes, internal energy of an ideal gas, heat capacities of an ideal gas, and adiabatic processes for an ideal gas); SECOND LAW OF THERMODYNAMICS (directions of thermodynamic processes, heat engines, internal-combustion engines, refrigerators, second law of thermodynamics, Carnot cycle, entropy, and microscopic interpretation of energy); ELECTRIC CHARGE AND ELECTRIC FIELD (electric charge, conductors, insulators, and induced charges, Coulomb's law, electric field and electric forces, electric-field calculations, electric field lines, and electric dipoles); GAUSS'S LAW (charge and electric flux, calculation of electric flux, Gauss's law and its applications, and charges on conductors); ELECTRIC POTENTIAL (electric potential energy, electric potential, calculation of electric potential, equipotential surfaces, and potential gradient); CAPACITANCE AND DIELECTRICS (capacitors and dielectrics, capacitors in series and parallel, energy storage in capacitors and electric-field energy, dielectrics, molecular model of induced charge, and Gauss's law in dielectrics); CURRENT, RESISTANCE, AND ELECTROMOTIVE FORCE (electric current, resistivity, resistance, electromotive force and circuits, energy and power in electric circuits, and theory of metallic conduction); DIRECT-CURRENT CIRCUITS (resistors in series and parallel, Kirchhoff's rules, electrical measuring instruments, R-C circuits, and power distribution system); MAGNETIC FIELD AND MAGNETIC FORCES (magnetism, magnetic field, magnetic field lines and magnetic flux, motion of charged particles in a magnetic field, applications of motion of charged particles, magnetic force on a current-carrying conductor, force and torque on a current loop, direct-current motor, and Hall effect); SOURCES OF MAGNETIC FIELD (magnetic field of a moving charge, magnetic field of a current element, magnetic field of a straight current-carrying conductor, force between parallel conductors, magnetic field of a circular current loop, Ampere's law and its applications, and magnetic materials); ELECTROMAGNETIC INDUCTION (induction experiments, Faraday's law, motional electromotive force, induced electric fields, Eddy's currents, displacement current and Maxwell's Equations, and superconductivity); INDUCTANCE (mutual inductance, self-inductance and inductors, inductors and magnetic-field energy, R-L circuit, L-C circuit, and L-R-C series circuit); ALTERNATING CURRENT (phasors and alternating current, resistance and reactance, L-R-C series circuit, power in alternating-current circuits, resonance in alternating-current circuits, and transformers); and ELECTROMAGNETIC WAVES (Maxwell's equations and electromagnetic waves, plane electromagnetic waves and speed of light, sinusoidal electromagnetic waves, energy and momentum in electromagnetic waves, standing electromagnetic waves, and electromagnetic spectrum). **(Lecture/Lab hrs: 150 & Credits: 10)**

10.3 Biology – II (IUSOM—BO—PreMed—02—03)

Biology – II course required during the second semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—02—03) is cited below **(Lecture/Lab hrs: 150 & Credits: 10)**:

10.3.1 Purpose

The purpose of this course is to familiarize the medical students with the basic concepts that comprise the science of living organisms. This is an overview of the different branches of biological sciences. This course will provide the introductory foundation for further studies encountered in subsequent semesters of both Premed and M.D. programs.

10.3.2 Goal

The course goal is to provide students a solid foundation in biological sciences.

10.3.3 Objectives

The objectives of this Biology – II course are that upon its completion, a student should be able to: 1. Understand how scientists work. 2. Know the characteristics of life. 3. Understand how life perpetuates and adapts. 4. Know how the structure of living organisms is organized. 5 Have a basic knowledge of animal and plant physiology. 6. Understand how life interacts with its environment. 7. Understand basic biochemical processes of living organisms.

10.3.4 Prerequisites

General Chemistry – I, Physics – I, Biology – I and Calculus taken during the first semester of PreMed program at IUSOM are prerequisites.

10.3.5 Format

A traditional lecture/discussion format with the aid of MS PowerPoint slide presentations will be used to present course materials. Additionally, students will be provided with the opportunity to participate in regularly scheduled laboratory sessions designed to enhance student understanding of biological phenomena.

10.3.6 Textbooks for Biology – II

The following textbooks and support materials are required / recommended for this Biology – II course:

Required:

1. CAMBELL BIOLOGY (2011) by Jane B. Reece, Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Robert B. Jackson, Publishers: Pearson Education, 9th Edition, ISBN-10: 0321739752 or ISBN-13: 978-0321739759.

Recommended:

2. BIOLOGY: LIFE ON EARTH WITH PHYSIOLOGY (2010) by Gerard Audesirk, Teresa Audesirk, and Bruce E. Byers, Publishers: Benjamin Cummings, 9th Edition, ISBN-10: 0321598466 or ISBN-13: 978-0321598462.

10.3.7 Description of the Biology – II Course Contents

The subject matter to be covered in the Biology – II course (IUSOM—BO—PreMed—02—03) is as follows:
DESCENT WITH MODIFICATION: A DARWINIAN VIEW OF LIFE; THE EVOLUTION OF POPULATIONS; THE ORIGIN OF SPECIES; PHYLOGENY AND SYSTEMATICS; THE TREE OF LIFE: AN INTRODUCTION TO BIOLOGICAL DIVERSITY; PROKARYOTES; THE ORIGINS OF EUKARYOTIC DIVERSITY; PLANT DIVERSITY: HOW PLANTS COLONIZED LAND AND THE EVOLUTION OF SEED PLANTS; FUNGI; AN INTRODUCTION TO ANIMAL EVOLUTION; INVERTEBRATES; VERTEBRATE EVOLUTION AND DIVERSITY; PLANT STRUCTURE, GROWTH AND DEVELOPMENT; TRANSPORT IN VASCULAR PLANTS; PLANT NUTRITION; ANGIOSPERM REPRODUCTION AND BIOTECHNOLOGY; and PLANT RESPONSES TO INTERNAL AND EXTERNAL SIGNALS. **(Lecture/Lab hrs: 150 & Credits: 10)**

10.4 Organic Chemistry – I (IUSOM—BO—PreMed—02—04)

Organic Chemistry – I course required during the second semester of PreMed at IUSOM (Code: IUSOM—BO—PreMed—02—04) is cited below **(Lecture/Lab hrs: 150 & Credits: 10)**:

10.4.1 Purpose

This Organic Chemistry – I course has been designed to teach organic chemistry to those students who have career interests not in chemistry but in biology, medicine and other life sciences, the main purpose being to provide an opportunity, which is only one, to such students, to learn some practical applications of organic chemistry.

10.4.2 Goal

After introducing to fundamental concepts from the most elementary ideas, the students shall be provided solid basis in principals and modern applications of organic chemistry in the context of high quality medicine and its general practice, especially not ignoring the role of molecular biology from the mechanistic point of view, which is of utmost importance.

10.4.3 Objectives

A student with ultimate interest in medicine, after completing this course, is anticipated to be able to understand very clearly the concept of: 1. The structural theory of organic chemistry. 2. Resonance structures. 3. Atomic and molecular orbitals. 4. Hybridization. 5. Functional groups. 6. Typical organic compounds such as alkanes, alkenes and alkynes together with aromatics, haloalkanes, alcohols, ethers, nitrogen containing organics, carbonyl compounds. 7. Organic reactions and their mechanisms. 8. Acid — base reactions including the standard free-energy change. 9. IUPAC nomenclature. 10. Conformational analysis. 11. Enantiomers and their resolution and chiral molecules including biological importance of chirality as well as stereoisomers. 12. Optical activity. 13. Synthesis of chiral molecules as well as chiral drugs. 14. Nucleophilic substitution (S_N1 and S_N2) and elimination (E1 and E2) reactions. 15. Addition reactions of alkenes and alkynes. 16. Fourier Transform Infrared (IR), Nuclear Magnetic Resonance (NMR) and Mass Spectrometric (MS) techniques for structural elucidation of organics. 17. Applying this

overwhelming knowledge of organic chemistry without any doubt and confusion in the safe and cautious practice of medicine with human beings and other living bodies.

10.4.4 Prerequisites

General Chemistry – I, Physics – I, Biology – I and Calculus taken during the first semester of PreMed program at IUSOM are prerequisites.

10.4.5 Format

The course materials in the form of lecture/discussion shall be presented and tested in a somewhat traditional format using state-of-the-art and highly modern audio-visual technologies, namely, Media Portfolio: Your Presentation Resource CD-ROM (dual platform) (ISBN 01-301-7686-9), MS PowerPoint Slides, Transparencies, Prentice Hall Test Manager (ISBN 01-301-7670-2) as software, and Annotated Instructor's Edition (with Guide to Media Resources) on CD-ROM.

10.4.6 Textbooks for Organic Chemistry – I

The following textbooks and support materials are required / recommended for this Organic Chemistry – I course:

Required:

1. ORGANIC CHEMISTRY (2009) by T.W.G. Solomons and Craig B. Frythe, Publishers: John Willey & Sons, 10th Edition, ISBN-10: 0470401419 or ISBN-13: 978-0470401415.

Recommended:

2. MECHANISTIC ASPECTS OF THE THERMAL FORMATION OF HALOGENATED ORGANIC COMPOUNDS INCLUDING POLYCHLORINATED DIBENZO-*p*-DIOXINS (1983) by Ghulam G. Choudhry and Otto Hutzinger, Publishers: Taylor and Francis, ISBN: 06-770-6130-7.

10.4.7 Description of the Organic Chemistry – I Course Contents

The subject matter to be covered in the Organic Chemistry - I course (IUSOM—BO—PreMed—02—04) is as follows:

CARBON COMPOUNDS AND CHEMICAL BONDS (introduction, development of organic chemistry as a science, structural theory of organic chemistry, chemical bonds: the octet rule including exceptions, writing Lewis structures, formal , resonance, quantum mechanics, atomic orbitals, molecular orbitals, structure of methane and ethane: sp^3 hybridization, calculated molecular models: electron density surfaces, structure of ethene: sp^2 hybridization, structure of ethyne: *sp* hybridization, quantum mechanics, molecular geometry: valence shell electron pair repulsion model, and representation of structural formulas); REPRESENTATIVE CARBON COMPOUNDS: FUCTIONAL GROUPS, INTERMOLECULAR FORCES, AND INFRARED (IR) SPECTROSCOPY (structure and function: organic chemistry, nanotechnology, and bioengineering, carbon—carbon covalent bonds, hydrocarbons: alkanes, alkenes, alkynes, and aromatic compounds, polar covalent bonds, calculated molecular models: maps of electrostatic potential, polar and nonpolar molecules, functional groups, alkyl halides (haloalkanes), alcohols, ethers, amines,

aldehydes and ketones, carboxylic acids, esters, and amides, nitriles, physical properties and molecular structure, attractive electric forces, attractive electric forces, organic templates engineered to mimic bone growth, and infrared (IR) spectroscopy: an instrumental method for detecting functional groups); INTRODUCTION TO ORGANIC REACTIONS: ACIDS AND BASES (shuttling the protons, reactions and their mechanisms, HOMOs and LUMOs in reactions, heterolysis of bonds to carbon: carbocation and carbanion, use of curved arrows in illustrating reactions, strength of acids and bases: k_a and pk_a, predicting the outcome of acid—base reaction, relationship between structure and acidity, energy changes, relationship between equilibrium constant and the standard free energy change ($\underline{\wedge}G^o$), acidity of carboxylic acids, effect of solvent on acidity, organic compounds as bases, a mechanism for an organic reaction, carbonic anhydrase, acids and bases in nonaqueous solutions, and acid—base reactions and the synthesis of deuterium- and tritium-labeled compounds); ALKANES: NOMENCLATURE, CONFORMATIONAL ANALYSIS, AND AN INTRODUCTION TO SYNTHESIS (flexible or inflexible: molecular structure making the difference, introduction to alkanes and cycloalkanes, shapes alkanes, IUPAC nomenclature of alkanes, alkyl halides, and alcohols, nomenclature of cycloalkanes, alkenes and cycloalkenes, and alkynes, physical properties of alkanes and cycloalkanes, sigma bonds and bond rotation, conformational analysis of butane, relative stability of cycloalkanes: ring strain, origin of ring strain in cyclopropane and cyclobutane: angle strain and torsional strain, conformations of cyclohexane, nanoscale motors and molecular switches, substituted cyclohexanes: axial and equatorial hydrogen atoms, disubstituted cycloalkanes: cis—trans isomerism, bicyclic and polycyclic alkanes, pheromones: communication by means of chemicals, chemical reactions of alkanes, synthesis of alkanes and cycloalkanes, general principles of structure and reactivity, introduction to organic synthesis, and from the inorganic to the organic); STEREOCHEMISTRY: CHIRAL MOLEULES (handedness of life, biological significance of chemistry, isomersism: constitutional isomers and stereoisomers, enantiomers and chiral molecules, biological importance of chirality, historical origin of stereochemistry, tests for chirality: planes of symmetry, nomenclatures of enantiomers: *R,S*-system, properties of enantiomers: optical activity, origin of optical activity, synthesis of chiral molecules, chiral drugs, selective binding of drug enantiomers to left- and right-hand coiled DNA, molecules with more than one stereogenic center, Fischer projection formulas, stereoisomerism of cyclic compounds, relating configurations through reactions devoid of cleavage bonds of stereogenic carbons, separation of enantiomers: resolution, compounds with stereogenic centers other than carbon, and chiral molecules that don't have a tetrahedral atom with four different groups); IONIC REACTIONS: NUCLEOPHILIC SUBSTITUTION AND ELIMINATION REACTIONS OF ALKYL HALIDES (breakage of cell walls with organic chemistry, introduction, nucleophilic substitution reactions, nucleophiles, leaving groups, kinetics of nucleophilic substitution reaction: an S_N2 reaction, mechanism for the S_N2 reaction, transition state theory: free-energy diagram, stereochemistry of S_N2 reactions, reaction of *tert*-butyl chloride with hydroxide ion: an S_N1 reaction, mechanism for S_N1 reaction, carbocations, stereochemistry of S_N1 reactions, factors effecting S_N1 and S_N2 reactions, organic synthesis: functional group transformation using S_N2 reactions, biological methylation: a biological nucleophilic substitution reaction, elimination reactions of alkyl halides, the E2 reaction, the E1 reaction, and substitution versus elimination); ALKENES AND ALKYNES: PROPERTIES AND SYNTHESIS AS WELL AS ELIMINATION

REACTIONS OF ALKYL HALIDES (cell membrane fluidity, introduction, the (*E*)—(*Z*) system for designating alkene diastereomers, relative stabilities of alkenes, cycloalkenes, synthesis of alkenes via elimination reactions, dehydrohalogenation of alkyl halides, acid—base dehydration of alcohols, carbocation stability and the occurrence of molecular rearrangements, synthesis of alkynes by elimination reactions, acidity of terminal alkynes, replacement of the acetylenic H atom of terminal alkynes, hydrogenation of alkenes, hydrogenation in the food industry, hydrogenation: the function of the catalyst, homogeneous asymmetric catalytic hydrogenation: involving *L* – DOPA, (*S*) – Naproxen, and Aspartame, hydrogenation of alkynes, and structural information from molecular formulas and the index of hydrogen deficiency); ALKENES AND ALKYNES: ADDITION REACTIONS (the sea: a treasury of biologically active natural products, introduction, addition to alkenes, addition of hydrogen halides to alkenes: Markonikov's rule, stereochemistry of the ionic addition to an alkene, addition of sulfuric acid to alkenes, addition of water to alkenes: acid-catalyzed hydration, alcohols from alkenes through oxymercuration—demercuration: Markovnikov addition, alcohols from alkenes through hydroboration—oxidation: Anti-Markonikov syn hydration, hydroboration: synthesis of alkylboranes, oxidation and hydrolysis of alkylboranes, alkene hydration methods, protonolysis of alkylboranes, addition of bromine and chlorine to alkenes, stereochemistry of the addition of halogens to alkenes, halohydrin formation, regiospecificity in unsymmetrically substituted bromonium ions: bromonium ions of ethene, propene, and 2 – methylpropene, divalent carbon compounds: carbenes, oxidations of alkenes: sys – 1,2-dihydroxylation, catalytic asymmetric dihydroxylation, oxidative cleavage of alkenes, addition of bromine and chlorine to alkynes, addition of hydrogen halides to alkynes, oxidative cleavage of alkynes, synthesis strategies, and cholesterol biosynthesis: elegant and familiar reactions in nature); and NUCLEAR MAGNETIC RESONANCE (NMR) AND MASS SPECTROMETRY (MS): TOOLS FOR STRUCTURE DETERMINATION (a thermos of liquid helium, introduction, the electromagnetic spectrum, nuclear magnetic spectrometry (NMR), nuclear spin: the origin of the signal, shielding and deshielding of protons, the chemical shift, chemical shift equivalent and nonequivalent protons, signal splitting: spin—spin coupling, proton NMR spectra and rate processes, carbon- 13 NMR spectroscopy, two-dimensional (2D) NMR techniques, magnetic resonance imaging (MRI) in medicine, introduction to mass spectrometry (MS), the mass spectrometer, the mass spectrum, determination of molecular formulas and molecular weights, fragmentation, gas chromatographic – mass spectrometric (GC – MS) analysis, and mass spectrometry of biomolecules). **(Lecture/Lab hrs: 150 & Credits: 10)**

11. Courses for the Third Semester of PreMed (IUSOM—BO—PreMed—03--00)

At IUSOM, the courses required for the third semester of PreMed program (IUSOM—BO—PreMed—03—00) are mentioned below in full details **(Total Lecture/Lab hrs: 600 & Total Credits: 40)**.

11.1 General Chemistry – III (IUSOM—BO—PreMed—03—01)

General Chemistry – III course required during the third semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—03—01) is cited below **(Lecture/Lab hrs: 150 & Credits: 10)**:

11.1.1 Purpose

This General Chemistry - III Course has been designed to continue to teach chemistry to those students who have career interests not in chemistry but in biology, medicine and other life sciences, the main purpose being to provide an opportunity, which is only one, to such students, to learn additional practical applications of chemistry.

11.1.2 Goal

After introducing to additional fundamental concepts from the most elementary ideas, the students shall be provided solid basis in additional principals and modern applications of chemistry in the context of high quality medicine and its general practice, especially not ignoring the role of molecular biology, which is of utmost importance.

11.1.3 Objectives

A student with ultimate interest in medicine, after completing this course, is anticipated to be able to understand very clearly the concept of: 1. Changes in entropy and free energy. 2. Electrochemical reactions. 3. Metals and nonmetals. 4. Transition elements. 5. Complex ions. 6. Coordination compounds. 7. Nuclear Chemistry. 8. Basic organic chemistry. 9. Biochemical reactions.

11.1.4 Prerequisites

General Chemistry – I & II, Physics – I & II, Biology – I & II, and Calculus taken during the first and second semesters of PreMed program at IUSOM are prerequisites.

11.1.5 Format

The course materials in the form of lectures/discussions shall be presented and tested in a traditional format using modern audiovisual equipments, like LCD projectors, MS PowerPoint presentations, and overhead transparencies.

11.1.6 Textbooks for General Chemistry – III

The following textbooks and support materials are required /recommended for this General Chemistry – III course:

Required:

1. GENERAL CHEMISTRY: PRINCIPLES AND MODERN APPLICATIONS (2006) by Ralph H. Petrucci, William S. Harwood, and F.G. Herring, Publishers: Prentice Hall, 9th Edition, ISBN-10: 0131493302 or ISBN-13: 978-0131493308.

Recommended:

2. GENERAL CHEMISTRY (2004) by John W. Hill, Ralph H. Petrucci, Terry W. McCreary, and Scott S. Perry, Publishers: Prentice Hall, 4th Edition, ISBN-10: 0131402838 or ISBN-13: 978-0131402836.

11.1.7 Description of the General Chemistry – III Course Contents

The subject matter to be covered in the General Chemistry – III course (IUSOM—BO—PreMed—03—01) is as follows:

SPONTANEOUS CHANGE: ENTROPY AND FREE ENERGY: (spontaneity: definition of spontaneous change, concept of entropy, evaluating entropy and entropy changes, criteria for spontaneous change: second law of thermodynamics, standard free energy change ($\underline{\wedge} G^o$), free energy change and equilibrium constant (K_{eq}) and as functions of temperature, coupled reactions, and focus: coupled reactions in biological systems); ELECTROCHEMISTRY (electrode potentials and their measurement, standard electrode potentials, cell potentials for redox reaction (E^o_{cell}), relationship between E_{cell}, $\underline{\wedge} G$, and K_{eq}, E_{cell} as a function of concentrations, batteries: producing electricity via chemical reactions, corrosion: unwanted voltaic cells, electrolysis: causing nonspontaneous reactions to occur, industrial electrolysis processes, and focus: membrane potentials,); MAIN—GROUP ELEMENTS: METALS (group 1: alkali metals, group 2: alkaline earth metals, ions in natural waters: hard water, group 13: metals: aluminum, gallium, indium, and thallium, group 14: tin and lead, and focus: gallium arsenide); MAIN—GROUP ELEMENTS: NONMETALS (group 18: noble gases, group 17: halogen family, group 16: oxygen family, group 15: nitrogen family, group 14: carbon and silicon, group 13: boron, and focus: gloss making); TRANSITION ELEMENTS (general properties, principles of extracting metallurgy, metallurgy of iron and steel, first-row transition metal elements: scandium to manganese, iron triad: iron, cobalt, and nickel, group 11: copper, silver, and gold, group 12: zinc, cadmium, and mercury, lanthanides, and focus: high—temperature superconductors); CPMLEX IONS AND COORDINATION COMPOUNDS (Werner's theory of coordination compounds: an overview, ligands, nomenclature, isomerism, bonding in complex ions: crystal field theory, magnetic properties of coordination compounds and crystal field theory, color and the color of complexes, aspects of complex-ion equilibria, acid—base reactions of complex ions, some kinetic considerations, applications of coordination chemistry, and focus: colors in gemstones); NUCLEAR CHEMISTRY (radioactivity, radioactive isotopes: naturally occurring, nuclear reactions and artificially induced radioactivity, transuranium elements, rate of radioactive decay, energetics of nuclear reactions, nuclear stability, nuclear fission, nuclear fusion, effect of radiation on matter, applications of radioisotopes, and focus: radioactive waste disposal); ORGANIC CHEMISTRY (an overview of organic compounds and structure, alkanes, alkenes and alkynes, aromatic hydrocarbons, alcohols, phenols, and ethers, aldehydes and ketones, carboxylic acids and their derivatives, amines, heterocyclic compounds, nomenclature of stereoisomers, introduction to substitution reactions at sp^3 hybridized carbon atoms, synthesis of organic compounds, polymerization reactions, focus: natural and synthetic dyes); and CHEMISTRY OF THE LIVING STATE (chemical structure of living matter: an overview, lipids, carbohydrates, proteins, aspects of metabolism, nucleic acids, focus: protein synthesis and the genetic code). **(Lecture/Lab hrs: 150 & Credits: 10)**

11.2 Physics – III (IUSOM—BO—PreMed—03—02)

Physics – III course required during the third semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—03—02) is cited below **(Lecture/Lab hrs: 150 & Credits: 10):**

11.2.1 Purpose

This Physics – III course has been designed to teach optics and modern physics to those students who have career interests not in physics but in biology, medicine and other life

sciences, the main purpose being to provide an opportunity, which is only one, to such students, to learn some practical applications of such branches of physics.

11.2.2 Goal

The course goal is to provide students, through lecture presentations, a manageable synopsis of the fundamental principals of calculus-based physics covering optics and modern physics and how to apply them to life sciences including medicine.

11.2.3 Objectives

The objectives of this Physics – III course are to assist students to: 1. Develop conceptual understanding of two branches of physics, namely, optics and modern physics. 2. Build strong problems-solving skills concerning such fields of physics, when applied them to medicine.

11.2.4 Prerequisites

General Chemistry – I & II, Physics – I & II, Biology – I & II, and Calculus taken during the first and second semesters of PreMed program at IUSOM are prerequisites

11.2.5 Format

The course materials in the form of lectures/discussions shall be presented and tested in a traditional format using modern audiovisual equipments, like LCD projectors, MS PowerPoint presentations, overhead transparencies, CDs and DVDs.

11.2.6 Textbooks for Physics – III

The following textbooks and support materials are required / recommended for this Physics – III course:

Required:

1. SEARS AND ZEMANSKY'S UNIVERSITY PHYSICS: WITH MODERN PHYSICS (2007) by Hugh D. Young and Roger A. Freedman, Publishers: Pearson, Addison, and Wesley, 12th Edition, ISBN-10: 0321501314 or ISBN-13: 978-0321501318.

Recommended:

2. PHYSICS (2009) by John D. Cutnell and Kenneth W. Johnson, Publishers: John Wiley & Sons, 8th Edition, ISBN-10: 0470223553 or ISBN-13: 978-0470223550.

11.2.7 Description of the Physics – III Course Contents

The subject matter to be covered in the Physics – III course (IUSOM—BO—PreMed—03—02) is as follows:

THE NATURE AND PROPAGATION OF LIGHT (the nature of light, reflection and refraction, total internal reflection, dispersion, polarization, scattering of light, and Huygen's principle); GEOMETRIC OPTICS AND OPTICAL INSTRUMENTS (reflection and refraction at alpine surface, reflection at a spherical surface, refraction at a spherical surface, thin lenses, camera, the eye, the magnifier, and microscopes and telescopes); INTERFERENCE (interference and coherent sources, two-source interference of light, intensity in interference patterns, interference in thin films, and the Michelson

interferometer); DIFFRACTION (Fresnel and Fraunhofer diffraction, diffraction from a single slit, intensity in the single-slit pattern, the diffraction grating, X-ray diffraction, circular apertures and resolving power, and holography); RELATIVITY (invariance of physical laws, relativity of simultaneity, relativity of time intervals, relativity of length, the Lorentz transformation, the Doppler's effect for electromagnetic waves, relativity momentum, relativistic work and energy, and Newtonian mechanics and relativity); PHOTONS, ELECTRONS, AND ATOMS (emission and absorption of light, the photoelectric effect, atomic line spectra, and energy levels, the nuclear atom, the Bohr model, the laser, x-ray production and scattering, continuous spectra, and wave-particle duality); THE WAVE NATURE OF PARTICLES (De Broglie Waves, electron diffraction, probability and uncertainty, the electron microscope, and wave functions); QUANTUM MECHANICS (particle in a box, potential wells, potential barriers and tunneling, the harmonic oscillator, and three-dimensional problems); ATOMIC STRUCTURE (the hydrogen atom, the Zeeman effect, electron spin, multi-electron atoms and the exclusion principle, and X-ray spectra); MOLECULES AND CONDENSED MATTER (types of molecular bonds, molecular spectra, structure of solids, energy bands, free-electron model of metals, semiconductors, semiconductor devices, and superconductivity); NUCLEAR PHYSICS (properties of nuclei, nuclear binding and nuclear structure, nuclear stability and radioactivity, activities and half-lives, biological effects of radiation, nuclear reactions, nuclear fission, and nuclear fusion); and PARTICLE PHYSICS AND COSMOLOGY (fundamental particles: a history, particle accelerators and detectors, quarks, the standard model and beyond, the expanding universe, and the history of the universe). **(Lecture/Lab hrs: 150 & Credits: 10)**

11.3 Biology – III (IUSOM—BO—PreMed—03—03)

Biology – III course required during the third semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—03—03) is cited below **(Lecture/Lab hrs: 150 & Credits: 10)**:

11.3.1 Purpose

The purpose of this Biology – III course is to familiarize the medical students with the basic concepts that comprise the science of living organisms. This is an overview of the different branches of biological sciences. This course will provide the introductory foundation for further studies encountered in subsequent semesters of both Premed and M.D. programs.

11.3.2 Goal

The course goal is to provide students a solid foundation in biological sciences.

11.3.3 Objectives

The objectives of this Biology – III course are that upon its completion, a student should be able to: 1. Understand how scientists work. 2. Know the characteristics of life. 3. Understand how life perpetuates and adapts. 4. Know how the structure of living organisms is organized. 5 Have a basic knowledge of animal and plant physiology. 6. Understand how life interacts with its environment. 7. Understand basic biochemical processes of living organisms.

11.3.4 Prerequisites

General Chemistry – I & II, Physics – I & II, Biology – I & II, Organic Chemistry – I and Calculus taken during the first and second semesters of PreMed program at IUSOM are prerequisites

11.3.5 Format

A traditional lecture/discussion format will be used to present course materials with the support of MS PowerPoint slides and LCD projectors. Additionally, students will be provided with the opportunity to participate in regularly scheduled laboratory sessions designed to permit first hand experience in the field of biology.

11.3.6 Textbooks for Biology – III

The following textbooks and support materials are required / recommended for this Biology – III course:

Required:

1. CAMBELL BIOLOGY (2011) by Jane B. Reece, Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Robert B. Jackson, Publishers: Pearson Education, 9th Edition, ISBN-10: 0321739752 or ISBN-13: 978-0321739759.

Recommended:

2. BIOLOGY: LIFE ON EARTH WITH PHYSIOLOGY (2010) by Gerard Audesirk, Teresa Audesirk, and Bruce E. Byers, Publishers: Benjamin Cummings, 9th Edition, ISBN-10: 0321598466 or ISBN-13: 978-0321598462.

11.3.7 Description of the Biology – III Course Contents

The subject matter to be covered in the Biology – III course (IUSOM—BO—PreMed—03—03) is as follows:
BASIC PRINCIPLES OF ANIMAL FORM AND FUNCTION; ANIMAL NUTRITION; CIRCULATION AND GAS EXCHANGE; THE IMMUNE SYSTEM; REGULATING THE INTERNAL ENVIRONMENT; CHEMICAL SIGNALS IN ANIMALS; ANIMAL REPRODUCTION; ANIMAL DEVELOPMENT; NERVOUS SYSTEM; SENSORY AND MOTOR MECHANISMS; AN INTRODUCTION TO ECOLOGY AND THE BIOSPHERE; ANIMAL BEHAVIOR AND BEHAVIORAL ECOLOGY; POPULATION ECOLOGY; COMMUNITY ECOLOGY; ECOSYSTEMS; and CONSERVATION BIOLOGY AND RESTORATION ECOLOGY. **(Lecture/Lab hrs: 150 & Credits: 10)**

11.4 Organic Chemistry – II (IUSOM—BO—PreMed—03—04)

Organic Chemistry – II course required during the third semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—03—04) is cited below **(Lecture/Lab hrs: 150 & Credits: 10)**:

11.4.1 Purpose

This Organic Chemistry – II course has been designed to teach organic chemistry to those students who have career interests not in chemistry but in biology, medicine and other life sciences, the main purpose being to provide an opportunity, which is only one, to such students, to learn some additional practical applications of organic chemistry.

11.4.2 Goal

After introducing to additional fundamental concepts from the most elementary ideas, the students shall be provided solid basis in additional principals and modern applications of organic chemistry in the context of high quality medicine and its general practice, especially not ignoring the role of molecular biology from the mechanistic point of view, which is of utmost importance.

11.4.3 Objectives

A student with ultimate interest in medicine, after completing this course, is anticipated to be able to understand very clearly the concept of: 1. Free radical reactions. 2. Structures, nomenclatures, synthesis, and physical and chemical properties (including reactions) of alcohols and ethers, and carbonyl organic compounds, namely, aldehydes and ketones. 3. Synthesis and reactions of conjugated unsaturated compounds. 4. Aromatic compounds and aromatic substitution reactions. 5. Nucleophilic additions to the carbonyl groups of aldehydes and ketones together with their aldol reactions. 6. Ultraviolet—Visible (UV—Vis) spectroscopy. 7. Organic reactions and their mechanisms. 8. Organometallic Reagents and their reactions. 9. Oxidation—reduction reactions. 10. Applying this overwhelming knowledge of organic chemistry without any doubt and confusion in the safe and cautious practice of medicine with human beings and other living bodies.

11.4.4 Prerequisites

General Chemistry – I & II, Physics – I & II, Biology – I & II, Organic Chemistry – I and Calculus attended during the first and second semesters of PreMed program at IUSOM are prerequisites.

11.4.5 Format

The course materials in the form of lecture/discussion shall be presented and tested in a somewhat traditional format using state-of-the-art and highly modern audio-visual technologies, namely, Media Portfolio: Your Presentation Resource CD-ROM (dual platform) (ISBN 01-301-7686-9), MS PowerPoint Slides, Transparencies, Prentice Hall Test Manager (ISBN 01-301-7670-2) as software, and Annotated Instructor's Edition (with Guide to Media Resources) on CD-ROM.

11.4.6 Textbooks for Organic Chemistry – II

The following textbooks and support materials are required / recommended for this Organic Chemistry - II course:

Required:

1. ORGANIC CHEMISTRY (2009) by T.W.G. Solomons and Craig B. Frythe, Publishers: John Willey & Sons, 10th Edition, ISBN-10: 0470401419 or ISBN-13: 978-0470401415.

Recommended:

2. MECHANISTIC ASPECTS OF THE THERMAL FORMATION OF HALOGENATED ORGANIC COMPOUNDS INCLUDING POLYCHLORINATED

DIBENZO-*p*-DIOXINS (1983) by Ghulam G. Choudhry and Otto Hutzinger, Publishers: Taylor and Francis, ISBN: 06-770-6130-7.

11.4.7 Description of the Organic Chemistry – II Course Contents

The subject matter to be covered in the Organic Chemistry – II course (IUSOM—BO—PreMed—03—04) is as follows:

RADICAL REACTIONS (Calicheamicin gamma$_1^I$:a radical device for slicing the backbone of DNA, introduction, radicals in biology, medicine, and industry, hemolytic bond dissociation energies, reactions of alkanes with halogens, chlorination of methane: its reaction mechanism and energy changes, halogenation of higher alkanes, geometry of alkyl radicals, reactions generating tetrahedral stereogenic carbons, radical addition to alkenes: the Anti-Markonikov addition of hydrogen bromide, radical polymerization of alkenes: chain—growth polymers, and other important radical reactions); ALCOHOLS AND ETHERS (molecular hosts, structure and nomenclature, physical properties, alcohols: their synthesis from alkenes, reactions, behaviors as acids, conversions into alkyl halides via reactions with hydrogen halides, phosphorous tribromide, or thionyl chloride, tosylates, mesylates and triflates: as leaving group derivatives of alcohols, alkyl phosphates, ethers: theirs synthesis and reactions, epoxides: their reactions, sharpless asymmetric epoxidation, chemistry of epoxides, carcinogens, and biological oxidation, anti 1,2-dihydroxylation of alkenes via epoxides, chemistry of environmentally friendly alkene oxidation methods, and Crown ethers: nucleophilic substitution reactions); ALCOHOLS FROM CARBONYL COMPOUNDS: OXIDATION—REDUCTION AND ORGANOMATALLIC COMPOUNDS (two aspects of the coenzyme NADH, introduction, oxidation—reduction reactions in organic chemistry, alcohols via reduction of carbonyl compounds, alcohol dehydrogenase, stereoselective reductions of carbonyl groups, oxidation of alcohols, organometallic compounds, preparation of organolithium and organomagnesium compounds and their reactions, alcohols from Grignard reagents, lithium dialkylcuprates: the Corey—Posner and Whitesides—House synthesis, and protecting groups); CONJUGATED UNSATURATED SYSTEMS (synthesis of morphine involving Diels—Alder reaction, introduction, allylic substitution and the allyl radical, the stability of the allyl radical, the allyl cation, rules for resonance, alkadienes and polyunsaturated hydrocarbons, 1,3- Butadiene: electron delocalization, the stability of conjugated dienes, ultraviolet—visible (UV—Vis) spectroscopy, the photochemistry of vision, eletrophilic attack on conjugated dienes: 1,4-addition, and the Diels—Alder reaction: a 1,4-cycloaddition reactions of dienes); AROMATIC COMPOUNDS (green chemistry, introduction, nomenclature of benzene derivatives, benzene: modern theories on its structure, Kekule structure, stability, and reactions, Huckel's Rule: the 4n + 2 pi-electron rule, other aromatics, chemistry of nanotubes, heterocyclic aromatic, aromatics in biochemistry, spectroscopy of aromatics, and chemistry of sunscreens: catching the sun's rays and their fate); REACTIONS OF AROMATIC COMPOUNDS (biosynthesis of thyroxine: aromatic substitution involving iodine incorporation, electrophilic aromatic substitution reactions and the mechanism involving arenium ions, benzene: its halogenation, nitration, and slufonation, Friedel—Crafts reactions: alkylation, acylation, and their limitations, synthetic applications of Friedel—Crafts acylation: the Clemmensen reduction, effect of substituents on reactivity and orientation, theory of substituent effects on electrophilic aromatic substitution, reactions of the side chain of alkyl benzenes and their

synthetic applications, industrial styrene synthesis, alkenylbenzenes, allylic and benzylic halides in nucleophilic substitution reactions, and reduction of aromatics); ALDEHYDES AND KETONES: NUCLEOPHILIC ADDITIONS TO THE CARBONYLYL GROUP (vitamin B_6, introduction, nomenclature, physical properties, synthesis, nucleophilic addition to carbon—oxygen double bond, the addition of alcohols: hemiacetals and acetals, the addition of primary and secondary amines, chemistry of pyridoxal phosphate, addition of hydrogen cyanide, addition of Ylides: the Wittig reaction, addition of organometallic reagents: the Reformatsky reaction, oxidation of aldehydes and ketones, chemical analysis for aldehydes and ketones, and spectroscopic properties of aldehydes and ketones); and ALDEHYDES AND KETONES: ALDOL REACTIONS (triose phosphate recycles carbon via an enol, acidity of the alpha-hydrogens of carbonyl compounds: enolate anions, keto and enol tautomers, reactions via enols and enolate anions, the aldol reactions: addition of enolate anions to aldehydes and ketones, retro-aldol reaction in glcolysis—dividing assets to double the ATP yield, crossed aldol reactions, cyclizations via aldol condensations, lithium enolates, chemistry of silyl enol ethers, alpha-selenation: a synthesis of alpha,beta-unsaturated carbonyl compounds, additions to alpha,beta-unsaturated carbonyl compounds, and chemistry of Calicheamicin $gamma_1^I$ activation for cleavage of DNA). **Lecture/Lab hrs: 150 & Credits: 10)**

12. Courses for the Fourth Semester of PreMed (IUSOM—BO—PreMed—04--00)

At IUSOM, the courses required for the fourth semester of PreMed program (IUSOM—BO—PreMed—04—00) are mentioned below in full details **(Total Lecture/Lab hrs: 600 & Total Credits: 40)**.

12.1 English: On Medicine (IUSOM—BO—PreMed—04—01)

English: On Medicine course required during the fourth semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—04—01) is cited below **(Lecture/Class hrs: 150 & Credits: 10)**:

12.1.1 Purpose

The purpose of this course is to familiarize the medical students with the subject of English relevant to Medicine and to present to them a well organized, informative, and focused course in English that emphasizes the essential writing training of the universal language, namely, English that students must possess in order to study and eventually practice medicine with great success.

12.1.2 Goal

To provide a comprehensive coverage of English language focusing three topics such as The Disease, The Patient, and The Physician together with to provide a solid foundation upon which to build the practitioner's knowledge of this language.

12.1.3 Objectives

The objectives of this college English course concentrating on writing are that, upon its completion, a student should be able to: 1. Write plainly and clearly. 2. Have knowledge for the ways of constructing arguments. 3. Synthesize materials to compose a research paper. 4.

Use punctuation and documentation. 5. Have knowledge about, in short, everything we can think of having to do with writing essays. 6. Read and discuss full-length books, stories and essays.

12.1.4 Prerequisites

High School level English taken prior to enrolling for PreMed program at IUSOM is prerequisite.

12.1.5 Format

A traditional lecture/discussion format will be used to present course materials using MS PowerPoint slide presentation techniques. In addition, during this course, the students will be asked to use their built-up skills to read books by scientists, physicians and writers on medicine and about various aspects of medicine or the practice of this discipline.

12.1.6 Textbooks for English: On Medicine

The following textbooks and support materials are required / recommended for this English: On Medicine course:

Required:

1. THE BEDFORD HANDBOOK (2005) by Diana Hacker, Publishers: Bedford / St. Martins, 7th Edition, ISBN-10: 0312419333 or ISBN-13: 978-0312419332.

Recommended:

2. THE JOHNS HOPKINS GUIDE TO LITERARY THEORY AND CRTICISM (2004) by Michael Groden, Martin Kreiswirth, and Imre Szeman (Eds.), Publishers: The Johns Hopkins University Press, 2nd Edition, ISBN-10: 0801880106 or ISBN-13: 978-0801880100.

12.1.7 Description of the English: On Medicine Course Contents

For English: On Medicine course (IUSOM—BO—PreMed—04—01), the medical students are required to write three essays and three book reviews along with to give one short talk, as detailed below:

First Essay (#1)

Writing About How a Machine Works. The basic aim of the science essay is often explanation, and the basis of good scientific writing an ability to put something technical or complicated into English a reader can understand, and so we begin here.

Imagine your audience is someone with one or two years of college, someone who can read and enjoy *Scientific American*, *The American Scientist* or *Nature* and explain to him or her:

why an airplane flies; or
why a cathedral doesn't fall down; or
how some aspect of the Internet works; or
how to use a computer; or
how a radio or TV or car or roller coaster or ferris wheel or bicycle or vacuum cleaner or coffee-maker or microwave oven or zipper or other household or personal

appliance (e.g., eyeglasses, hearing aids, a wheelchair, food-processor, thermometer, doorknob) works.

The sort of object or process you, as a medical student, are to choose is something that is man-made or depends on knowledge or manipulation or transformations of nature that are done by people. It can therefore also be an object that is the result of a mechanical or artificial or chemical process initiated by man, such as glass or steel. You can describe the process by which the object has been made or its history.

You can also choose ordinary everyday processes. Cooking is not only an art; it is based on knowledge of nature. How did a bunch of eggs and flower and milk become a cake? How did people learn to brew beer? What's wine? There's a history behind ices.

Moreover, remember a machine or man-made object need not be made of metal or plastic, and it can be used for aesthetic pleasure or emotional uplift: you can explain how any musical instrument works or the history of how it comes to take the form it does. A ballet-shoe is a man-made object which enables women to dance on the edge of their toes. Furniture and toys may be included. How does a zipper work? Your object need not be something technologically sophisticated; it can be a light-bulb or a pencil or a fountain pen.

You, as a student, can look at obsolete or older inventions: the windmill or a medieval knight's armor. You can explain the process whereby a book is made or history of book-making. You can also explain intellectual inventions like calendars. You can write this satirically. Pretend you are a person from a community with no knowledge or experience of such objects and use your description to criticize the society which uses such objects. You can write this personally: tell how you or other members of your household or school use the object. In all cases, you should have a thesis-statement and a context. You should in the essay include the reason why your reader ought to know how your machine or process works. You don't want your reader to be asking him or herself, 'why should I read this?'. To those who are saying to themselves, 'I'm not a scientist, I don't know the first thing about how things work. I turn the key in my car and it goes, period', I say, come in at the level that is natural to you and that will be natural to a college-level reader.

Remember clarity is a special concern in the natural sciences. The intent here is to practice using language which is jargon-free and analogies which actually help readers to visualize and explain something.

Suggestions:
It is suggested you do some minimal research, and, therefore, you must document your sources and all verbatim quotations or paraphrases. We will review documentation before this essay is due. You may of course do research, but if you do please make sure your source is reliable and respected (e.g., the *Encyclopedia Britannica* or a specialized encyclopedia in the relevant field is a wonderful source, but *World Book, Colliers*, and such like junk are out. If you take information from the World Wide Web or an e-mail group of any kind, be prepared to verify the expertise of the person whose e-mail you are quoting or the respectability of the host of the website whose information you are relying upon.

Length: 3-5 double-spaced typed pages.

Second Essay (#2)
Observing Nature. To be a good physician you must learn to observe accurately and disinterestedly; the conveying of information based on such observation is another basic aim of writing in the natural sciences.

Thus for your second essay, you are given the choice of writing about how an animal, or a plant, or some species of natural phenomena behaves. The idea of this essay is to describe nature in an objective and unbiased way, to say in words what it is one observes, and in so doing to explain something which occurs in the natural world without any man-made intervention or transformation.

Suggestions:
You might try to develop or confirm a hypothesis about an animal or plant. Here what you do is research patterns of birth or development and watch their strategies for survival, for, obtaining food, for sleep, for creating an environment for themselves, for mating, for interactions with one another. The reason it's good to start with a hypothesis is it can help you decide what to look for as you watch and, if you like, questions for further research.

Type 1: If you choose an animal, it is suggested that you pick an animal and observe it at length. Take detailed notes on your observations. We do not forbid the use of pets as we often know our pets very well; however, you must use your pet to generalize about the species of animal from: do not write an essay on your best friend and the solace of your existence.

Type 2: A plant is a good choice if you are a gardener already, or if you have plants in your house.

Type 3: You can rely on a memory or a long-extended or repeated experience of natural phenomena. However, we will not accept a description of a video -- if you have never seen a lion except in a video, lions are out; the same things goes for earthquakes or tornados. The idea is to observe something which has not been prepared by someone else for you. You must use natural phenomena which you can observe. Thus, unless you have access to a sophisticated telescope, stars & comets are out.

Type 4: Anything you have done in a laboratory in a science course is encouraged even if it occurred a couple of terms ago. This too will require that you remember what you did. You must also rewrite your work in good essay format.

Not Allowed: Finally, human beings are out since we do not want social satire, or a researched archaeological essay.

On research see the comment on Essay #1 above. The same remarks about clarity, research and length that apply to Essay #1 apply to Essay #2.

Length: 3-5 double-spaced typed pages.

Third Essay (#3)
Medicine. Finally we will examine the youngest science: medicine. But since this is not a pre-med course, we will be discussing not so much how to perform a Caesarian section or how to diagnose some illness, but rather how the science of medicine has radically changed our attitudes towards sickness and death and how medicine really is practiced in hospitals and at home in this country.

Suggestions:

1. You may write about how an illness has been treated in the past and is treated today. It need not be a lethal epidemic, but there is a good deal of literature on such illnesses. Examples: small pox, TB, influenza, cholera, measles, AIDS.
2. You may write about a particular case history or medical problem. These include prolonging the life of someone who has permanently lost consciousness and procedures which are controversial. Examples: miscarriages (not well understood), artificial insemination, abortion, various kinds of very expensive procedures to replace organs.
3. You may write some aspect of the medical profession. You can write about the way a hospital is organized; the education required of doctors and nurses or technicians. Questions you can ask yourself include: should nurse practitioners replace doctors in some aspect of daily care; if so, do they have to be better educated? what do we mean by better educated?
4. You may discuss how our society should control and pay for medical treatment since it can powerfully affect individual lives and is expensive.
5. We encourage students to write about their own experiences or those of close family members or friends. Part of the point of this part of the term's work is to encourage you to think for him or herself, take initiatives, consider how the social and psychological and economical realities surrounding illness have affected your own life or the life of someone you are closely connected to.

This is to be a researched essay, but you are also encouraged to use personal experiences. Four good sources are required, but one of them may be Golub's *The Limits of Medicine* and another an interview with an experts or people who have had the illness you are writing about.

The Annotated Bibliography: As part of the researched essay, you will be asked to hand in an annotated bibliography. An annotated bibliography provides short summaries and evaluations of the books and essays used in a research paper. The skill of synopsis will be reviewed. Models will be provided.

An Abstract: You will also be asked to hand in an abstract of your own essay. We will in class learn to and practice the art of writing abstracts, of summarizing, paraphrasing, and writing synopses.

Length: 4-6 double-spaced typed pages.

Three Book Reviews:
Analyzing Science Writing. You will be asked to write three book reviews. If you ever become a professional in any field, you may find yourself asked to review books and articles.

There is a specific format which is followed which we will learn about. The first review is to be on both Feynman books when we finish reading them. The second review is to be on those parts of *Darwin's Voyage of the Beagle* and *The Darwin Reader* that have been assigned. The third review is to be on Golub's *The Limits of Medicine*. The book reviews are also intended to provide practice on how to select, elaborate upon and judge sources.

We will discuss how a good book review usually includes some or all of the following points:

1. the book's context and intended audience;
2. its thesis or theses;
3. your evaluative statement about this thesis and the book's content;
4. a synopsis or summary of its contents;
5. an analysis of the book to reveal how the author's background or biases help or hinder the author and the quality of the evidence.

We will review the skills needed for literary analysis.

Length: 3-4 double-spaced pages.

The Short Talk. Talk is primary and writing secondary. We believe everyone can learn to write more clearly and enjoy writing more if he or she would only learn to talk on paper, to use the real language he or she might use in the classroom or any other natural situation which demands certain coherence. Our course Bible, John Trimble's *Writing With Style* is based on this belief. A writer must learn to think of his material as something he is communicating to someone else; not something he or she is mumbling to him or herself in the hopeless hope that no-one will actually read it, much less read it aloud. To do a short talk forces the student to experience these assumptions.

Thus, each student will be asked to prepare a coherent seven to fifteen minute talk for classroom presentation on the readings from one of the five books which is due the day he or she is scheduled to talk upon. The talks will begin the third week of the semester. The idea is to practice inventing a clear thesis-statement which is supported by concrete details from a text or your own experience.

The whole class will listen and try to respond; their response will tell the student whether he or she has made him or herself clear; the ensuing dialogue and the student's own later thoughts about either what happened when he or she or another student talked will (it is hoped) teach everyone something about the basis of writing -- again, clear thinking in clear language which comes naturally to the speaker-writer.

Each student is asked to hand in an outline or cards (hand-written or typed) which he or she used to talk from, and I will return this material with the grade for the talk in the following session.

Other Requirements:
Assumptions behind this course: Instructor thinks that 1) something is to be gained by coming to class, and that we all can learn a great deal from one another; 2) good writing can be discussed in simple words, and exemplified, learned, practiced, and improved through imitation of models; and 3) the only way to improve one's writing is by much practice over a long period of time.

We have observed that people who write well are people who read a lot; thus:
1. *Class work*: We want everyone to attend class faithfully, to read all the books, and to participate in class discussions. If you miss a shorter writing assignment in class, you must make it up, but you must then type or print it from a computer. We ask that you limit your unexcused absences to a minimum; we regard weeks' of absence as one basis for a failing grade.

2. *Writing Assignments*: We have allowed time for 1) revision of each essay; 2) discussion of student models to help you see what is expected and give you ideas on how to go about a particular task; and d) the class as a single group to listen to, analyze and comment on one or more of the essays someone in the class has written. We will try our best to write comments on your essays which can help you how better to organize your thoughts, correct your grammar, and write more gracefully, clearly and naturally. We will also attempt to help you think more deeply about your thesis or subject. **(Lecture/Class hrs: 150 & Credits: 10)**

12.2 Introduction to Anatomy (IUSOM—BO—PreMed—04—02)

Introduction to Anatomy course required during the fourth semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—04—02) is cited below **(Lecture/Lab hrs: 120 & Credits: 8):**

12.2.1 Purpose

The purpose of Introduction to Anatomy course is to familiarize the medical students with the parts of the human body, their relationships with one another and the clinical correlations due to diseases like injuries, infections and congenital abnormalities.

12.2.2 Goal

The course goal of Introduction to Anatomy is to equip the future doctors with a fundamental knowledge of the anatomy of the human body, making them more prepare to tackle the difficulties they may encounter during their clinical experiences, when they have to deal with the abnormal or diseased human body.

12.2.3 Objectives

After the completion of this anatomy course, the student is expected to be able to describe, enumerate and draw any specific and particular part, organ, or region of the human body in order for them to correlate these facts with the presenting signs or symptoms of their future patients, and help them in making their correct diagnosis.

12.2.4 Prerequisites

General Chemistry – I, II & III, Physics – I, II & III, Biology – I, II & III, Organic Chemistry – I & II and Calculus attended during the first, second, and third semesters of PreMed program at IUSOM are prerequisites.

12.2.5 Format

The course materials in the form of lectures/discussions shall be presented and tested in a traditional format using modern audiovisual equipments, like LCD projectors, MS PowerPoint presentations, overhead transparencies and human models.

12.2.6 Textbooks for Introduction to Anatomy

The following textbooks and support materials are required / recommended for this Introduction to Anatomy course:

Required:

1. CLINICALLY ORIENTED ANATOMY (2009) by Keith L. Moore, Arthur F. Dalley, and Anne M.R. Agur, Publishers: Lippincott, Williams and Wilkins, 6th Edition, ISBN-10: 0781775256 or ISBN-13: 978-0781775250.

Recommended:

2. ATLAS OF HUMAN ANATOMY (2010) by Frank H. Netter, Publishers: Saunders, 5th Edition, ISBN-10: 1437709702 or ISBN: 978-1437709704.
3. DIAGNOSTIC IMAGING (2009) by Peter Armstrong, Martin Wastie, and Andrea Rockall Publishers: Wiley-Blackwell, 6th Edition, ISBN-10: 1405170395 or ISBN-13: 978-1405170390.
4. A.D.A.M. Interactive Anatomy V4.0 Windows Version DVD (2005), Publishers: Ventura Education System, 3/E.

12.2.7 Description of the Introduction to Anatomy Course Contents

The subject matter to be covered in the Introduction to Anatomy course (IUSOM—BO—PreMed—04—02) is as follows:

INTRODUCTION TO CLINICALLY ORIENTED ANATOMY (approaches to studying anatomy, anatomicomedical terminology, anatomical variations, skin and fascia, skeletal system, muscular system, cardiovascular, lymphatic system, nervous system, and medical imaging techniques: radiography, computed tomography (CT), ultrasonography, magnetic resonance imaging (MRI), and nuclear medicine imaging); THORAX (thoracic wall, thoracic cavity and viscera, and medical imaging of the thorax: radiography, echocardiography, CT and MRI scanning); ABDOMEN (abdominal cavity, peritoneum and peritoneal cavity, abdominal viscera, thoracic diaphragm, posterior abdominal wall, and medical imaging of the abdomen; PELVIS AND PERINEUM (pelvis, viscera of pelvic cavity, perineum, and medical imaging of pelvis and perineum: radiography,

echocardiography, CT and MRI scanning); BACK (vertebral column, muscles of the back, spiral cord and meninges, medical imaging of the back: radiography, myelography, CT and MRI scanning); LOWER LIMB (bones of lower limb, fascia, vessels, and nerves of the lower limb, organization of thigh muscles, gluteal region, posterior thigh muscles, popliteal fossa, leg, foot, joints of the lower limb, posture and gait, and medical imaging of the lower limb: radiography, arteriography, CT and MRI scanning); UPPER LIMB (bones of the upper limb, superficial structures of the upper limb, lymphatic drainage, anterior thoracoappendicular of the upper limb, posterior thoracoappendicular and scapulohumeral muscles, axilla, arm, forearm, hand, joints of the upper limb, and medical imaging of the upper limb: radiography, ultrasonography, arteriography, CT and MRI scanning); HEAD (skull, face, scalp, cranial meninges, brain, orbit, temporal region, temporomandibular joint (TMJ), pterygopalatine fossa: it contents, nose, ear, and medical imaging of the head: radiography, ultrasonography, CT and MRI scanning); NECK (bones, fascia, superficial and lateral muscles, triangles, deep structures, viscera, lymphatics in the neck, and medical imaging of the neck: radiography, ultrasonography, CT and MRI scanning); and CRANIAL NURVES (CN): THEIR SUMMARY (an overview, olfactory nerve (CN I), optic nerve (CN II), oculomotor nerve (CN III), trochlear nerve (CN IV), trigeminal nerve(CN V), abducent nerve (CN VI), facial nerve (CN VII), vestibulocochlear nerve (CN VIII), glossopharyngeal nerve (CN IX), vagus nerve (CN X), accessory nerve (CN XI), and hypoglossal nerve (CN XII)). **(Lecture/Lab hrs: 120 & Credits: 8)**

12.3 Introduction to Molecular Cell Biology (IUSOM—BO—PreMed—04—03)

Introduction to Molecular Cell Biology course required during the fourth semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—04—03) is cited below **(Lecture/Lab hrs: 120 & Credits: 8)**:

12.3.1 Purpose

The purpose of this Introduction to Molecular Cell Biology course is to familiarize the pre-medical students with the basic parts and interpretation of microscopic anatomy. The students will better understand how structure and function are integrated in the molecules, cells, tissues, and organs of a living creature. Introduction to Molecular Cell Biology course centers on the biology of cells and tissues within an organism, and as such, serves as the foundation on which pathology and pathophysiology are built.

12.3.2 Goal

The course goal is to provide students a solid foundation in basic cellular anatomy and function.

12.3.3 Objectives

The objectives of this Introduction to Molecular Cell Biology course are that upon its completion, a student should have some knowledge and foundations for: 1. Identifying clinically important structures of human cells and tissues. 2. Identifying human cells and tissues. 3. Understanding the relationships between structure and function in cells and tissues. 4. Understanding the mechanisms by which cellular components communicate. 5. Understanding the specific microanatomy of cellular structures. 6. Understanding Genome

and Proteome Science as a tool for searching solutions for Avian Flue, SARS, and other infectious and non-infectious diseases.

12.3.4 Prerequisites

General Chemistry – I, II & III, Physics – I, II & III, Biology – I, II & III, Organic Chemistry – I & II and Calculus attended during the first, second, and third semesters of PreMed program at IUSOM are prerequisites.

12.3.5 Format

A traditional lecture/discussion format will be used to present course materials with the support of MS PowerPoint slides and LCD projectors. Additionally, students will be provided with the opportunity to participate in regularly scheduled laboratory sessions designed to permit first hand experience in the field of Molecular Cell Biology.

12.3.6 Textbooks for Introduction to Molecular Cell Biology

The following textbooks and support materials are required / recommended for this Introduction to Molecular Cell Biology course:

Required:

1. MOLECULAR BIOLOGY OF THE CELL (2007) by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter, Publishers: Garland Science, 5th Edition, ISBN-10: 0815341059 or ISBN-13: 978-0815341055.

Recommended:

2. ATLAS OF BASIC HISTOLOGY COLOR (2003) by Irwin Berman, Publisher: McGraw-Hill / Appleton & Lange, 3rd Edition, ISBN: 00-714-0288-8.

12.3.7 Description of the Introduction to Molecular Cell Biology Course Contents

The subject matter to be covered in the Introduction to Molecular Cell Biology course (IUSOM—BO—PreMed—04—03) is as follows:
CELLS AND GENOMES; CELL CHEMISTRY AND BIOSYNTHESIS; PROTEINS; DNA AND CHROMOSOMES; DNA REPLICATION, REPAIR, AND RECOMBINATION; MECHANISMS IN READING THE GENOME IN BY CELLS; CONTROL OF GENE EXPRESSIONS; MANIPULATING PROTEINS, DNA, AND RNA; MEMBRANES: THEIR ELECTRICAL PROPERTIES AND TRANSPORT OF SMALL MOLECULES; INTRACELLULAR COMPARTMENTS AND PROTEIN SORTING; INTRACELLULAR VESICULAR TRAFFIC; ENERGY CONVERSION: MITOCHONDRIA AND CHLOROPLASTS; CELL COMMUNICATION; CYTOSKELETON; CELL CYCLE AND PROGRAMMED CELL DEATH; MECHANICS OF CELL DIVISION; CELL JUNCTIONS, CELL ADHESION, AND THE EXTRACELLULAR MATRIX; GERM CELLS AND FERTILIZATION; DEVELOPMENT OF MULTICELLULAR ORGANISMS; HISTOLOGY: LIVES AND DEATHS OF CELLS IN TISSUES; ADAPTIVE IMMUNE SYSTEM; and PATHOGENS, INFECTION, AND INNATE IMMUNITY. **(Lecture/Lab hrs: 120 & Credits: 8)**

12.4 Organic Chemistry – III (IUSOM—BO—PreMed—04—04)

Organic Chemistry – III course required during the fourth semester of PreMed program at IUSOM (Code: IUSOM—BO—PreMed—04—04) is cited below **(Lecture/Lab hrs: 210 & Credits: 14)**:

12.4.1 Purpose

This Organic Chemistry – III course has been designed to teach organic chemistry to those students who have career interests not in chemistry but in biology, medicine and other life sciences, the main purpose being to provide an opportunity, which is only one, to such students, to learn some additional practical applications of organic chemistry.

12.4.2 Goal

After introducing to additional fundamental concepts from the most elementary ideas, the students shall be provided solid basis in additional principals and modern applications of organic chemistry in the context of high quality medicine and its general practice, especially not ignoring the role of molecular biology from the mechanistic point of view, which is of utmost importance.

12.4.3 Objectives

A student with ultimate interest in medicine, after completing this course, is anticipated to be able to understand very clearly the concept of: 1. Nucleophilic addition—elimination at acyl carbon of carboxylic acids and their derivatives. 2. Chemistry of enolate ions. 3. Nomenclature, synthesis and physical and chemical properties of amines. 4. Nucleophilic aromatic substitutions at phenols and aryl halides. 5. Chemistry of carbohydrates and lipids. 6. Chemistry of amino acids and proteins. 7. Nucleic acid and protein synthesis. 8. Applying this overwhelming knowledge of organic chemistry without any doubt and confusion in the safe and cautious practice of medicine with human beings and other living bodies.

12.4.4 Prerequisites

General Chemistry – I, II & III, Physics – I, II & III, Biology – I, II & III, Organic Chemistry – I & II and Calculus attended during the first, second, and third semesters of PreMed program at IUSOM are prerequisites.

12.4.5 Format

The course materials in the form of lecture/discussion shall be presented and tested in a somewhat traditional format using state-of-the-art and highly modern audio-visual technologies, namely, Media Portfolio: Your Presentation Resource CD-ROM (dual platform) (ISBN 01-301-7686-9), MS PowerPoint Slides, Transparencies, Prentice Hall Test Manager (ISBN 01-301-7670-2) as software, and Annotated Instructor's Edition (with Guide to Media Resources) on CD-ROM.

12.4.6 Textbooks for Organic Chemistry – III

The following textbooks and support materials are required / recommended for this Organic Chemistry – III course:

Required:

1. ORGANIC CHEMISTRY (2009) by T.W.G. Solomons and Craig B. Frythe, Publishers: John Willey & Sons, 10th Edition, ISBN-10: 0470401419 or ISBN-13: 978-0470401415.

Recommended:

2. MECHANISTIC ASPECTS OF THE THERMAL FORMATION OF HALOGENATED ORGANIC COMPOUNDS INCLUDING POLYCHLORINATED DIBENZO-*p*-DIXINS (1983) by Ghulam G. Choudhry and Otto Hutzinger, Publishers: Taylor and Francis, ISBN: 06-770-6130-7.

12.4.7 Description of the Organic Chemistry – III Course Contents

The subject matter to be covered in the Organic Chemistry – III course (IUSOM—BO—PreMed—04—04) is as follows:

CARBOXYLIC ACID AND THEIR DERIVATIVES: NUCLEOPHILIC ADDITION—ELIMINATION AT THE ACYLCARBON (nylon 6, 6: a polyamide, introduction, nomenclature and physical properties, preparation of carboxylic acids, nucleophilic addition—elimination at the acyl carbon, acyl chlorides, carboxylic acid anhydrides, esters, amides, chemistry of penicillins, derivatives of carbonic acid, decarboxylation of carboxylic acids, chemistry of thiamines, chemical tests for acyl compounds, and step-growth polymers); SYNTHESIS AND REACTIONS OF BETA-DICARBONYL COMPOUNDS: ADDITIONAL CHEMISTRY OF ENOLATE IONS (5-fluorouracil: an enzyme inhibitor, introduction, Claisen condensation: synthesis of beta-keto esters, acetoacetic ester synthesis: synthesis of methyl ketones (substituted acetones), addition reactions of active hydrogen compounds, direct alkylation of esters and nitriles, alkylation of 1,3-dithianes, Knoevenagel condensation, Michael Additions, Mannich reaction, chemistry of a suicide enzyme substrate, synthesis of enamines: Stork enamine reactions, chemistry of antibody – catalyzed aldol condensation, barbiturates, thiols, sulfur Ylides, and disulfides, and thiol esters and lipid biosynthesis); AMINES (neurotoxins and neurotransmitters, nomenclature, physical properties and structures, basicity: amine salts, chemistry of high performance liquid chromatography (HPLC) resolution of enantiomers, biologically important amines, preparation, reactions including with nitrous acid, chemistry of *N*-nitrosoamines, replacement reactions of arenediazonium salts, reactions with sulfonyl chlorides, sulfa drugs: sulfanilamides, analysis, eliminations involving ammonium compounds, and alkaloids); PHENOLS AND ARYL HALIDES: NUCLEOPHILIC AROMATIC SUBSTITUTIONS (4-*tert*-butylcalix(4)arene: a chalice-shaped molecule, structure and nomenclature of phenols, naturally occurring phenols, physical properties of phenols synthesis of phenols, chemistry of polyketide anticancer antibiotic biosynthesis, reactions of phenols as acids, other reactions of the O—H group of phenols, cleavage of alkyl aryl ethers, reactions of the benzene ring of phenols, Claisen rearrangement, quinines, aryl halides: nucleophilic aromatic substitutions, chemistry of the Bombardier beetle's noxious spray, chemistry of bacterial dehalogenation of a PCBs (polychlorinated biphenyls) derivatives, spectroscopic analysis of phenols and aryl halides, electrophilic and cycloaddition reactions, transition metal organometallic compounds, and organic halides and organometallic compounds in the environments); CARBOHYDRATES (carbohydrate recognition in healing and diseases, introduction, monosaccharides and their reactions

including: mutarotation, glycoside formation, oxidation reactions, reduction reactions, and reactions with phenylhydrazine, synthesis and degradation, the D family of aldoses, Fischer's proof of the configuration of D-(+)-glucose, chemistry of stereoselective synthesis of all the L-aldohexoses, disaccharides, chemistry of artificial sweeteners, polysaccharides, chemistry of oligosaccharide synthesis on a solid support: the glycol assembly approach, other biologically important sugars, sugars that contain nitrogen, glycolipids and glycoproteins of the cell surface: cell recognition and the immune system, chemistry of vaccines against cancer, and carbohydrate antibiotics); LIPIDS (insulation for nerves, introduction, fatty acids and triacylglycerols, chemistry of olestra and other fat substitutes, chemistry of self – assembled monolayers: lipids in materials science and bioengineering, terpenes and terpenoids, steroids, prostaglandins, phospholipids and cell membranes, chemistry of STEALTH liposomes for drug delivery, and waxes); AMINO ACIDS AND PROTEINS (catalytic antibodies: designer catalysis, introduction, amino acids, synthesis of alpha-amino acids, polypeptides and proteins: their primary structure including some examples, synthesis, and purification and analysis, chemistry of sickle – cell anemia, secondary, tertiary, and quaternary structure of proteins, introduction to enzymes, lysozymes: mode of action of an enzyme, serine proteases, chemistry of some catalytic antibodies, hemoglobin: a conjugated protein, and proteomics); and NUCLEIC ACID AND PROTEIN SYNTHESIS (tools for finding families, introduction, nucleotides and nucleosides and their laboratory synthesis, deoxyribonucleic acid: DNA, RNA and protein synthesis, Determination of base sequence of DNA: the chain terminating (dideoxynucleotide method), laboratory synthesis of oligonucleotides, the polymerase chain reaction (PCR), and sequencing of the human genome: an instruction book for the molecules of life). (**Lecture/Lab hrs: 210 & Credits: 14)**