

# **Faculty of Sports Medicine & Physiotherapy**

## **SYLLABUS**

### **FOR**

#### **M.Sc. SPORTS BIOCHEMISTRY**

**(SEMESTER: I – IV)**

**(Credit Based Evaluation and Grading System)**

**Session: 2019-20**



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## **GURU NANAK DEV UNIVERSITY AMRITSAR**

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**(ii) Subject to change in the syllabi at any time.  
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M.Sc. (Sports Biochemistry) (Semester System)  
(Credit Based Evaluation and Grading System)

**Semester-I**

Course No.	C/E/I	Course Title	L	T	P	Total Credits
<b>Core Courses</b>						
SBL401	C	Biomolecules	4	0	0	4
SBL402	C	Molecular Biology	4	0	0	4
SBL403	C	Human Physiology	4	0	0	4
SBL404	C	Biostatistics	3	1	0	4
SBP410	C	Practicals in Molecular Biology	0	0	6	6
<b>Total</b>			15	1	6	22

**Semester-II**

Course No.	C/E/I	Course Title	L	T	P	Total Credits
<b>Core Courses</b>						
SBL451	C	Thermodynamics and Bioenergetics	4	0	0	4
SBL452	C	Metabolism of Carbohydrates and Lipids	4	0	0	4
SBL453	C	Essentials of Genetics	4	0	0	4
SBL454	C	Computer Applications	3	0	0	3
SBP461	C	Practical in Clinical Biochemistry-I	0	0	6	6
<b>Elective Course (3 Credits)</b>						
	E	<b>Elective Course/Optional Course</b>	3	0	0	3
<b>Total</b>			18	0	6	24

**\*List of Elective Courses:**

1. Evidence Based Practice in Allied Health Sciences - SPL690
2. Women Health and Exercise - SPL691

**Note:-**

**PSL-053 ID Course Human Rights & Constitutional Duties (Compulsory Paper) Students can opt. in any semester except Semester 1<sup>st</sup>. This ID Paper is one of the total ID Papers of this course.**

M.Sc. (Sports Biochemistry) (Semester System)  
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**Semester-III**

Course No.	C/E/I	Course Title	L	T	P	Total Credits
<b>Core Courses</b>						
SBL501	C	Enzymology	4	0	0	4
SBL502	C	Metabolism of Proteins and Nucleic Acids	4	0	0	4
SBP510	C	Practical in Microbiology	0	0	8	8
<b>Interdisciplinary Course</b>						
	I	Interdisciplinary Course	4	0	0	4
<b>Total</b>			12	0	8	20

**Semester-IV**

Course No.	C/E/I	Course Title	L	T	P	Total Credits
<b>Core Courses</b>						
SBL551	C	Molecular Cell Biology	4	0	0	4
SBL552	C	Medical Biochemistry	4	0	0	4
SBP561	C	Practical in Clinical Biochemistry-II	0	0	6	6
SBD562	C	Dissertation	0	0	6	6
<b>Total</b>			8	0	12	20

M.Sc. (Sports Biochemistry) (Semester System)  
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**A. Theory (Examination)**

**Instructions to Paper Setters:**

The paper setters should set 8 questions (of equal marks), two in each of the four sections (Section A to D, corresponding to the distribution in the syllabi). Further, the paper setters shall be instructed to make sub-sections (not exceeding 4) of the questions and allocate appropriate marks to the each section. The candidates shall be asked to attempt five questions by selecting one question from each section and the fifth question may be attempted from any section.

\* 1 hr of theory and dissertation is counted as 1 credit. 2 hr of practical /clinical training is counted as 1 credit.

**B. Practical Examination - 24 Credits**

Practical examination of 24 credits will be conducted at the end of 4<sup>th</sup> semester which includes patient evaluation and management, viva-voce etc.

**C. Dissertation – 24 Credits**

The topic of dissertation will be allocated in Second Semester and candidate will work for 2 semesters and submit a written thesis in 4<sup>th</sup> semester. The student will be awarded grade for the total number of credits earned in dissertation in II, III and IV semesters of study at the end of the IV semester.

***Practical Attachments***

To enable the students to acquire practicing in hand on skills, maximum emphasis will be laid on regular practical classes, demonstration and clinical practice. The students will undergo Clinical / Field training in GNDU Campus / Sports Authority of India (Various Centres), National institutes of Physiotherapy, Government Medical College Amritsar, other sporting centers and to the coverage of various tournaments as and when required and decided by BOC.

\* The credits earned by a candidate in practical and dissertation during different semesters will be evaluated at the end of the 4th semester and the grade will be determined accordingly.

\* A candidate shall be required to maintain minimum of 5.62 SGPA at the end of each semester. A student getting 'C' or lower grade in any course in this discipline will be treated as having failed in that course and shall have to repeat the core/elective courses/or repeat/opt. another course in lieu of interdisciplinary/outside department course with approval of Board of Control, and will have to obtain at least 'C+' grade in that course within specified period as per the prevailing rules. The weights of 'C' and lower Grades will not be counted in SGPA or CGPA (according to syndicate proceeding, dated: 24.5.2010, para no. 34).

Interdisciplinary/Optional Course: to be offered from outside the department.

M.Sc. (Sports Biochemistry) (Semester-I)  
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***SBL401: BIOMOLECULES***

**Mid Semester Examination: 20% weightage**  
**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Section – A**

**Introduction:**

Biological fitness of organic compounds, dimensions and shape of biomolecules, supramolecular assemblies and cell organelles. Structure of atoms, molecules and chemical bonds.

**Carbohydrates:** Definition importance and functions, families of monosaccharides and structure of carbohydrates, stereoisomerism and mutarotation, derivatives of monosaccharides, disaccharides, trisaccharides and polysaccharides (starch, glycogen, cellulose, dextrins), sugars of bacterial cell wall.

**Section – B**

**Water:** Physical properties and structure of water, hydrogen bonding, solvent properties of water, ionization of water, fitness of aqueous environment for living organisms.

**Lipids:** Definition, importance and functions, classification of lipids, fatty acids and essential fatty acids, general structure and functions of major lipid subclasses, acylglycerols, phosphoglycerides, sphingolipids, terpenes, steroids, eicosanoids.

**Vitamins and Minerals:** Definition, chemistry and functions of water and fat soluble vitamins, major trace minerals, their bound forms and functions.

**Section – C**

**Proteins:** Definition, importance and functions, amino acids as building blocks of proteins, essential amino acids, non-protein amino acids, structure of peptide bond, organizational levels of protein structure, relationship between primary and higher order structures, supramolecular assemblies of proteins, solubility, denaturation, functional diversity and species specificity of proteins, protein classification, chemical synthesis of polypeptides. Conformation of proteins: Ramachandran Plot, Secondary, tertiary and quaternary structure; domains; motif and folds. Stabilizing interactions: Vander waals, electrostatic, hydrogen bonding, Hydrophobic interactions. Stability of protein structure.

**Section – D**

**Porphyrins:** Nucleus and classification of porphyrins, important metallo porphyrins occurring in nature, chemical nature and physiological significance of bile pigment.

M.Sc. (Sports Biochemistry) (Semester-I)  
(Credit Based Evaluation and Grading System)

**Recommended Books:**

1. Nelson DL and Cox MM. (2013) Lehninger Principles of Biochemistry, 6th Edition. Macmillan Worth Publishers, New Delhi.
2. Berg JM, Tymoczko JL, Gatto GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co., New York.
3. Bender DA, Botham KM, Kennelly PJ, Rodwell VW and Weil PA (2015) Harper's Illustrated Biochemistry, 30th Edition, McGraw-Hill Medical Canada.
4. Voet D, Voet JG and Pratt CW (2015). Fundamentals of Biochemistry, 4 th Edition. John Wiley & Sons. New York.

M.Sc. (Sports Biochemistry) (Semester-I)  
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***SBL402: MOLECULAR BIOLOGY***

**Mid Semester Examination: 20% weightage**

**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Section – A**

**Structure and Functions of Nucleic Acids:**

The beginning of Molecular Biology; DNA: A carrier of genetic information, Chemical structure of DNA and Base composition, biologically important nucleotides, Watson-Crick model, Supercoiled DNA, structure of different types of nucleic acids, hydrolysis of nucleic acids. Conformation of nucleic acids: A-, B-, Z-, DNA, t-RNA, micro-RNA. Stability of nucleic acid structure.

**Section – B**

**DNA replication, repair and recombination:**

Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.

**Section – C**

**RNA synthesis and processing:** Structure and function of RNA polymerases. Transportation in prokaryotes Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

**Section – D**

**Protein synthesis and processing:** Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post- translational modification of proteins.

M.Sc. (Sports Biochemistry) (Semester-I)  
(Credit Based Evaluation and Grading System)

**Recommended Books:**

1. George M Malanciski (2008). Freifelder's Essentials of Molecular Biology, 4th edition. Narosa Publishing House, India.
2. Berg JM, Tymoczko JL, Gatto GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co., New York. 6 M.Sc
3. Allison A. Lizabeth (2012) Fundamental Molecular Biology, 2nd Edition. J Willey and Sons, Hoboken, New Jersey.
4. Freifelder D and Malacinski GM (2010) Essentials of Molecular Biology, 4th Edition, John and Bartlett Publishing, UK
5. Krebs JE., Kilpatrick ST. and Goldstein ES. (2013). Lewin' GENES XI, Jones & Bartlett Learning. Burlington, MA.
6. Alberts B., Johnson A., Lewis J., Mofgan D., Raff M., Roberts K and Walter P. (2014). Molecular Biology of the Cell. 6th Edition. Garland Science



M.Sc. (Sports Biochemistry) (Semester-I)  
(Credit Based Evaluation and Grading System)

**SBL403: HUMAN PHYSIOLOGY**

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**Mid Semester Examination: 20% weightage**

**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Section – A**

1. Introduction to human physiology, cells, tissues, organs and system organization.
2. Cell structure, transport through cell membrane, Classification of tissue.

**Section – B**

3. Nervous system , central and autonomic nervous system, organization, Structure and properties of nerve, transmission of impulse, resting and action potential, Reflex action, reflex arc.
4. Endocrine system - Different endocrine glands and their hormones, major functions, mode of action, feedback mechanism.
5. Digestive system- organs of GI tract and their major functions.

**Section – C**

6. Cardiovascular system- anatomy of heart and blood vessels, conduction system in heart, Normal ECG. Systemic, coronary and pulmonary circulation. Cardiac cycle, cardiac output and blood pressure.
7. Respiratory system- anatomy, mechanism of respiration, lung volume and capacities, external and internal respiration, transport of O<sub>2</sub> and CO<sub>2</sub>
8. Excretory system - anatomy, function, renal circulation, auto regulation of the circulation, Structural and functional unit, Urine formation.

**Section – D**

9. Reproductive system- Male reproductive system-Structure and Function.  
Female reproductive system - Structure and Function, menstrual cycle and pregnancy.
10. Immune system - Innate, acquired and active immunity, cell mediated and humoral mediated immunity. Auto immune disease and Immune deficiency disorders.

**References:**

1. Understanding Medical Physiology, R.L. Bijlani, (1995) J P Brothers Medical Publishers.
2. Text Book of Medical Physiology, Guyton Hall, (2003) Saunders Publishers.
3. Principles of Anatomy and Physiology. Tortora (2003). John Wiley and Sons.
4. Human Physiology, by C.C. Chatterjee, (2002) Medical Allied Agency,

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**SBL404: BIOSTATISTICS**

**Mid Semester Examination: 20% weightage**

**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Course Contents**

**Section – A**

**Statistical Method:** Collection of data, Frequency distribution and its graphical representation, Measures of central tendency, Dispersion, Skewness and Kurtosis moments

**Correlation and Regression:** Relationship between variables, covariance, Karl-Pearson's correlation coefficient, Spearman's rank correlation coefficient, Least square technique for regression lines (without proof), regression coefficients, relationship between correlation analysis and regression analysis.

**Section – B**

**Probability:** Mathematical definitions of probability of an even, Use of permutations and combinations in calculations of probability, conditional probability, additive and multiplication law of probability, random variables and its pmf, pdf, cdf, mathematical expectation and variances, Theoretical Distribution: Binomial, Poisson and Normal Properties of these distributions (applications only)

**Section – C**

**Hypothesis Testing:** Sample, population, statistics and parameters, null hypothesis, level of significance, Definitions of Chi-square 't' and 'F' variates and their pdf only, Application of these distributions in testing of hypothesis. (10 Lectures)

**Section – D**

**Analysis of Variance:** Meaning of analysis of variance with linear models, Analysis of variance for one way classified data, analysis of variance for two way classified data with one observation for cell, analysis of variance for two-way classified data with multiple but equal number of observations per cell (data analysis only).

**Recommended Books:**

1. Raghavarao, D.: Statistical Techniques in Agricultural and Biological research (1983), Oxford and IBH Publishing Co. [Chapters: 2,3,4,5,7,8,9 and 10].
2. Fowler, J., Cohen, L. and Jarvis, P.: Practical Statistics for Field Biology, 2nd Edition (1998), John Wiley and sons. [Chapters: 4,5,6,7 (7.1-7.6), 9(9.1-9.4), 12(12.1-12.7), 13(13.1-13.4, 13.6, 13.7), 14(14.1-14.5, 14.7), 15(15.3-15.8, 15.10- 15.11), 16(16.9-16.13), 17(17.1-17.3, 17.5-17.6, 17.8)].

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**L T P**  
**4 0 0**

***SBP410: PRACTICALS IN MOLECULAR BIOLOGY***

**Mid Semester Examination: 20% weightage**

**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Course Contents**

Isolation of genomic DNA from bacteria (E.coli) and human blood, Quantification of DNA using spectrophotometric method, Isolation of plasmid DNA from bacteria, Transformation of bacteria using  $\text{CaCl}_2$  heat shock method, Digestion of DNA using restriction endonucleases, Resolution and molecular weight estimation of fragmented DNA using agarose gel electrophoresis, Construction of restriction map by single and double digestion, Amplification of known DNA sequences by Polymerase Chain Reaction.

**Recommended Books:**

1. Ausbel FM, Brent R, Kingston RE, Moore DD, Sediman JG, Smith JA, Sruhi V (1989) Current Protocols in Molecular Biology, Greene Publishing and Wiley Interscience, NY.
2. Sambrook Joseph and Russell DW (2012) Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, NY.

M.Sc. (Sports Biochemistry) (Semester-II)  
(Credit Based Evaluation and Grading System)

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***SBL451: THERMODYNAMICS AND BIOENERGETICS***

**Mid Semester Examination: 20% weightage**  
**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Section – A**

**Principles of Chemical Thermodynamics:** Free energy, enthalpy and entropy. Equilibrium steady distribution and role In cellular metabolism, ATP Cycle. Energy charge of the cell, phosphorylation potential, proton motive force, concept of high energy bond. Chemical basis of high standard free energy of hydrolysis of ATP and other phosphorylated compounds and Thioesters. Secondary functions of proton gradient: Thermogenesis and role of trans-hydrogenation of NAD and NADP.

**Biological Oxidation and Reduction:** Redox reactions, reduction potentials standard reduction potentials. Nernst equation. Universal electron carriers (NAD<sup>+</sup>, NADP<sup>+</sup> and FAD, flavoproteins).

**Section – B**

**Mitochondria and Oxidative phosphorylation:** Structure and organization, mitochondrial electron carriers: Ubiquinone, cytochromes and iron sulfur proteins, determination of sequences of electron carriers. position and function of the four complexes of ETC, glycerophosphate shuttle, Redox loops, Q-cycle, proton motive force, the electrochemical potential gradient, thermodynamics of phosphorylation, inhibitors. Mitchells chemiosmotic hypothesis and experimental evidences. Generation of ROS and antioxidant mechanism. Metabolite transporters in mitochondria: ADP-ATP translocase, malate aspartate shuttle and phosphate carrier. ATP Synthase: Subunit structure, F<sub>0</sub>-F<sub>1</sub> rotor stator model, Binding change mechanism of ATP synthesis. Uncouplers, Thermogenesis. Regulation of oxidative phosphorylation, Respiratory control (P/O ratio).

**Section – C**

**Photophosphorylation in Bacteria:** General features of photophosphorylation, historical background, Hills reaction Hills reagents, photosynthetic pigments, light absorption by various photosynthetic pigments. Light harvesting systems of plants and microbes, Oxygenic and non-oxygenic photosynthesis. Structure and function of bacterial photochemical reaction centers (purple bacteria and green-sulfur bacteria, Halobacterium salinarum).

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**Photophosphorylation in Plants:** Structure of chloroplast, Molecular architecture of Photosystem I and Photosystem II, Z-scheme of photosynthetic electron flow, oxygen evolving complex. Action of Herbicides. ATP synthesis by photophosphorylation, chloroplast, ATP Synthase. Cyclic photophosphorylation and its significance. Thermodynamics and quantum yield of cyclic and non-cyclic photophosphorylation. Regulation of photo-phosphorylation. Evolution of mitochondria and chloroplast.

**Section – D**

**Bioluminescence.** Phenomenon and its biological significance. Applications of Bioluminescence: ATP estimation, GFP as marker protein or gene, bio-lighting.

**Recommended Books:**

1. Nelson, D.L. and Cox, M.M. (2005); Lehninger Principles of Biochemistry, Fourth Edition, W.H. Freeman and Company, N.Y. USA.
2. Voet, D and Voet, J.G, (2009) Biochemistry, John Wiley and Sons, N.Y. USA.
3. Garret, R.H. and Grisham, C.M. (2005) Biochemistry 3rd Edition, Thomson Learning INC.

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**L T P**  
**4 0 0**

**SBL452: METABOLISM OF CARBOHYDRATES AND LIPIDS**

**Mid Semester Examination: 20% weightage**

**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Section – A**

**Introduction to Metabolism:** Types of Metabolic Pathways, Experimental approaches to study metabolism, Basic principles/mechanisms of metabolic regulation. Basic concepts and design of metabolism. Some activated carriers in metabolism.

**Section – B**

**Carbohydrate Catabolism:** Digestion and absorption of carbohydrates, glycolysis, citric acid cycle, oxidative phosphorylation, pentose phosphate and other pathways, Degradation of di and polysaccharides.

**Section – C**

**Carbohydrate Anabolism:** Gluconeogenesis, Role of nucleotide diphosphate sugars, Biosynthesis of di and polysaccharides, Regulation of carbohydrate metabolism, photosynthesis.

**Section – D**

**Lipid Catabolism:** Digestion and absorption of lipids; transport of lipoproteins, Oxidation of fatty acids, Degradation of triacylglycerols, phosphoglycerides. Sphingolipids, Regulation of lipid Metabolism. Lipid Anabolism: synthesis of fatty acids, triacylglycerols, phosphoglycerides, sphingolipids, cholesterol, prostaglandins and other protanoids,

**Recommended Books:**

1. Berg JM, Tymoczko JL, Gatto GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co., New York.
2. Bender DA, Botham KM, Kennelly PJ, Rodwell VW and Weil PA (2015) Harper's Illustrated Biochemistry, 30th Edition, McGraw-Hill Medical Canada.
3. Nelson DL and Cox MM. (2013) Lehninger Principles of Biochemistry, 6th Edition. Macmillan Worth Publishers, New Delhi.
4. Voet D, Voet JG and Pratt CW (2015). Fundamentals of Biochemistry, 4 th Edition. John Wiley & Sons. New York.
5. Trevor Palmer, Philip L.R. Bonner (2014) Enzymes: Biochemistry, Biotechnology and Clinical Chemistry. 2nd Reprinted Edition, Wood Head Publishing Limited, Cambridge, UK.

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### ***SBL453: ESSENTIALS OF GENETICS***

**Mid Semester Examination: 20% weightage**  
**End Semester Examination: 80% weightage**

#### **Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

#### **Section – A**

##### **Introduction to Genetics; Mitosis and Meiosis**

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information. Interrelation between the cell structure and the genetics function, Mitosis, Meiosis (explaining Mendel's ratios).

##### **Mendelian Genetics and its Extension**

Principles of Inheritance, Chromosome theory of inheritance, Laws of Probability, Pedigree analysis, Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression, sex linked inheritance.

#### **Section – B**

##### **Extrachromosomal Inheritance**

Chloroplast mutation/Variation in Four o' clock plant and *Chlamydomonas*, Mitochondrial mutations in *Neurospora* and yeast, Maternal effects, Infective heredity, Kappa particles in *Paramecium*.

##### **Genetic Analysis and Mapping in Bacteria and Bacteriophages**

Conjugation; Transformation; Transduction, Recombination.

#### **Section – C**

##### **Linkage, Crossing Over and Chromosomal Mapping**

Linkage and crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics –an alternative approach to gene mapping.

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**Section – D**

**Mutations**

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy. Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations, Molecular basis of Mutations in relation to UV light and chemical mutagens, DNA repair mechanisms.

**Transposable genetic elements**

Prokaryotic transposable elements- IS elements, Composite transposons, Tn-3 elements; Eukaryotic transposable elements- Ac-Ds system in maize and P elements in *Drosophila*; Uses of transposons; Eukaryotic Viruses.

**Recommended Books:**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. Principles of Genetics. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
4. Russell, P. J. (2009). *iGenetics- A Molecular Approach*. III Edition. Benjamin Cummings.



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(Credit Based Evaluation and Grading System)

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### ***SBL454: COMPUTER APPLICATIONS***

**Mid Semester Examination: 20% weightage**

**End Semester Examination: 80% weightage**

#### **Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

#### **Section – A**

##### **Computer fundamentals and MS word**

Introduction to digital computers, Organization, Number system, I/O devices, Storage devices, MS-Windows basics, MS-office, MS-Word-Meaning of word- Processing, Creating, Saving, Printing Documents, Page Setup, Formatting, Spell-Check, Adding page numbers, Header and Footer, Macros, Creating tables, Converting table to text and vice-versa, Mail Merge Ms-Excel-spreadsheets, Using different types of formulae, Creating graphs and charts, Exporting charts to MS-Word, MS-Power Point, Creating presentations, Formatting, Adding effects and timings

#### **Section – B**

##### **Data Analysis**

Introduction to Data, Information, Database, DBMS (Advantages and disadvantages), MS-Access, Basics of MS Access, Introduction to SQL (Data retrieval) Data analysis and database-Brief description and tabulation of data

#### **Section – C**

##### **Statistical Analysis Tools**

Measure of central tendency and dispersion-Mean, Median, Mode, Range, Standard Deviation, Variance and Correlation coefficient using SPSS. Types of errors and level of significance, Tests of significance, (F and t-test); Chi-square tests

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**Section – D**

**Internet**

Internet basics, Introduction to internet and its applications-www, email, ftp. Virtual library and some useful sites on Internet-Searching MEDLINE on the Pubmed system from National Centre for Biotechnology and Information, Assessing full text journals on the internet and printing articles using End Note Databases (Genes Bank), search tools and software at <http://www.ncbi.nlm.nih.gov>. Restriction enzyme site digestion webcutter2.0 at <http://www.firsmarket.com/cutter/cut2.html> PCR and multiplex PCR guide and troubleshooting at <http://www.med.yale.edu/genetics/ward/tavi/Trblesht.html> Image analysis program at <http://www.scioncorp.com>

**Recommended Books:**

1. Sinha, P.K. (2004). Computer Fundamentals.
2. Peter Norton's Introduction to Computers, 6th.Ed.
3. Windows Based Computer Courses, Sumit Kumar, Maalti, Sandeep Sood JBD Publishers.
4. Gupta, S.C. (2008). Fundamentals of Statistics. Himalaya Publishing House.

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**L T P**  
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***SPL590: EVIDENCE BASED PRACTICE IN ALLIED HEALTH SCIENCES (ELECTIVE)***

**Mid Semester Examination: 20% weightage**

**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Section – A**

1. Introduction to evidence– based complementary medicine
2. Evidence–based health care
3. Evidence–based practices
4. Evidence–based decision making and management

**Section – B**

1. Types of evidence
  - a. Definition of evidence
  - b. Forms of evidence
  - c. Randomized controlled trials

**Section – C**

- d. Case–control studies
- e. Cohort studies

**Section – D**

1. Applying the evidence
  - a. Pathways, guidelines and protocols
  - b. Future directions for clinical effectiveness
2. Evaluation of effectiveness and efficiency of the process

**References:**

1. Martin Dawes, Philip Davies, and Alistair Gray, Evidence–Based Practice: A Primer for Health Care Professionals. Elsevier Publication.
2. Albert R. Roberts and Kenneth R. Yeager, Evidence–Based Practice Manual: Research and Outcome Measures in Health and Human Services, Oxford University Press.
3. Allen Rubin, Practitioner's Guide to Using Research for Evidence–Based Practice. John Willey & Sons Publication.
4. Domhnall MacAuley Thomas M Best, Evidence–based Sports Medicine. BMJ Books.
5. Kathryn Refshauge and Elizabeth Gass, Musculoskeletal Physiotherapy: Its Clinical Science and Evidence–Based Practice. Churchill Livingstone.
6. Allen Rubin, Statistics for Evidence–Based Practice and Evaluation. Cengage learning.  
Bernadette Melnyk, Ellen Fineout–Overholt, Evidence–Based Practice in Nursing and Healthcare: A Guide to Best Practice, Lippincott Williams & Wilkins.

M.Sc. (Sports Biochemistry) (Semester-II)  
(Credit Based Evaluation and Grading System)

**L T P**  
**4 0 0**

***SPL591: WOMEN HEALTH AND EXERCISE (ELECTIVE)***

**Mid Semester Examination: 20% weightage**

**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Section – A**

1. Gender difference in muscle morphology
2. Diagnosis and Treatment of Urinary Incontinence and Prolapse

**Section – B**

3. Anemia
4. Hypertension in Women

**Section – C**

2. Bone health: assessment and treatment of osteopenia and osteoporosis
3. Evaluation and Treatment of Common Musculoskeletal Complaints

**Section – D**

1. Exercise for the childbearing year
2. Exercise for adolescence
3. Exercise for the older woman

**References:**

1. Nadya Swedan (2001): Women's Sports Medicine and Rehabilitation. An Aspen Publication.
2. Mary Lloyd Ireland & Aurelia Nattiv (2002): The Female Athlete. Saunders Publication.
3. Cardozo L and Staskin D (2006): Textbook of Female Urology and Urogynaecology (2nd edn). London: Isis Medical Media Ltd.
4. Mantle J, Haslam J and Barton S (2004): Physiotherapy in Obstetrics and Gynaecology. (2nd ed.) London: Butterworth-Heinemann.
5. Sapsford R, Markwell S and Bullock-Saxton J (1998): Women's Health: A Textbook for Physiotherapists. London: WB Saunders Company Ltd.
6. Bo, K., Berghmans, L.C.M., Van Kampen, M., Morkved, S. (2007). Evidence-Based Physical Therapy for the Pelvic Floor: Bridging Science and Clinical Practice. London: Churchill Livingstone.

M.Sc. (Sports Biochemistry) (Semester-II)  
(Credit Based Evaluation and Grading System)

**L T P**  
**4 0 0**

***SBP 461: PRACTICALS IN CLINICAL BIOCHEMISTRY-I***

Preparation of buffer solutions, determination of pKa, pI and Measurement of absorption maxima. Demonstration of Beer-Lambert Law and study of its validation, Estimation of total and reducing sugars by spectroscopic methods, Isolation of glycogen, Acidic and enzymatic hydrolysis of polysaccharides, Measurement of optical rotation, Demonstration of phenomenon of inversion, Absorption maxima of aromatic amino acids, Estimation of protein by Biuret, Bradford, Lowry and UV methods. Demonstration of protein purification techniques. Paper chromatography of lipids and their characterization as saponification number, acid value and iodine number, Quantitative estimation of Vitamin C. Assay of enzymes of clinical importance like amylase, phosphatases and aminotransferases. Factors affecting enzyme activity. Estimation of Hb, serum cholesterol, creatine, uric acid, urea, triacylglycerides, HDL, LDL, bilirubin, blood sugar and serum electrolytes (Na<sup>+</sup>, K<sup>+</sup> and chloride) urine analysis for abnormal constituents.

**Recommended Books:**

1. Plummer D (2006) An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Co., New Delhi.
2. Wilson K and Walker J (2010) Principles and Techniques of Practical Biochemistry, Cambridge University Press, UK.
3. Boye R (2006) Modern Experimental Biochemistry, Pearson Education, Asia, New Delhi.

M.Sc. (Sports Biochemistry) (Semester-III)  
(Credit Based Evaluation and Grading System)

**L T P**  
**4 0 0**

***SBL 501: ENZYMOLOGY***

**Mid Semester Examination: 20% weightage**  
**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Section – A**

**Introduction to Enzymes:** Nomenclature, Classification and Characteristics of enzymes, Enzyme specificity, Cofactors, Co-enzyme and Prosthetic group

**Mechanism of Enzyme Action:** Nature of active site, identification of functional groups at active site, enzyme substrate complex, Factors responsible for catalytic efficiency of enzymes: Proximity and orientation, covalent catalysis, Acid base catalysis, Strain and distortion theory, Induced fit hypothesis.

**Section – B**

**Mechanism of Action of Selected Enzymes:** Chymotrypsin, Lysozyme, Carbonic anhydrase, Ribonuclease, Involvement of co-enzymes in enzyme catalyzed reactions, RNA molecules as enzymes

**Enzyme Kinetics:** A brief concept of bioenergetics and kinetics, Kinetics of single and bi-substrate enzyme catalyzed reactions, Michaelis Menten equation. Derivation of Michaelis Menten equation and determination of  $K_m$  and  $V_{max}$  values

**Section – C**

**Enzyme Inhibition:** reversible and irreversible inhibition, Kinetics of competitive, uncompetitive and non-competitive inhibition, Random, Ordered, Theorell & Chance, and Ping-pong mechanism, their rate equations and diagnostic plots, Substrate inhibition and activation, Effect of pH and temperature on rate of enzyme catalyzed reactions

**Regulation of Enzyme Activity:** Allosteric enzymes, control of metabolic pathways, Mechanism of Aspartate transcarbamylase, Sigmoidal behavior, sequential and concerted models, Reversible covalent modification and zymogen activation, Isozymes and their importance

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**Section – D**

**Enzyme Technology:**Extraction and purification of enzymes, Enzymes as analytical reagents, Immobilized enzymes, Biotechnological applications of enzymes, Application of enzymes in medicine and industry.

**Recommended Books:**

1. Berg JM, Tymoczko, JL, Gatto Jr GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co.
2. Nelson DL and Cox MM. (2017) Lehninger Principles of Biochemistry, 7<sup>th</sup> Edition. WH Freeman.
3. Palmer T and Bonner PL (2007) Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, 2<sup>nd</sup> Edition, Woodhead Publishing.
4. Voet and Voet (2010). Biochemistry, 4<sup>th</sup> Edition. John Wiley & Sons.

M.Sc. (Sports Biochemistry) (Semester-III)  
(Credit Based Evaluation and Grading System)

**L T P**  
**4 0 0**

***SBL 502: METABOLISM OF PROTEINS AND NUCLEIC ACIDS***

**Mid Semester Examination: 20% weightage**  
**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Course Contents**

**Section – A**

**Metabolism of Nitrogen:**

Digestion and absorption of proteins, Nitrogen fixation and its mechanism, Assimilation of ammonia, Nitrogen cycle.

**Catabolism of Amino Acids:**

General reactions of amino acids metabolism i.e. transamination, deamination, decarboxylation, Urea cycle, Catabolism of individual amino acids.

**Section – B**

**Anabolism of amino acids:**

Biosynthesis of essential and non-essential amino acids, Regulation of amino acid biosynthesis

**Metabolism of amino acids precursors:**

Metabolism of Porphyrins: Biomedical importance, Heme biosynthesis, Genetic disorders of heme metabolism, catabolism of heme bilirubin: its conjugation and secretion, Hyperbilirubinaemia.

**Section – C**

**Degradation of Nucleotides:**

Degradation of purines and pyrimidines, Salvage pathways

**Biosynthesis of Nucleotides:**

Biosynthesis of purine and pyrimidine nucleotides, Biosynthesis of deoxyribonucleotides, Biosynthesis of nucleotide coenzymes, Regulation of nucleotide biosynthesis.



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**Section – D**

**Integration of Metabolism:**

Recurring motifs in biochemistry, regulation of major metabolic pathways, metabolic fates of glucose-6-phosphohate, pyruvate and acetyl CoA, Metabolic profiles of brain, muscle, adipose tissue, liver and kidney, Hormonal regulation of metabolism, metabolic adaptations.

**Recommended Books:**

1. Berg JM, Tymoczko, JL, Gatto Jr GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co.
2. Rodwell V, Weil PA, Botham KM, Bender D, Kennelly PJ (2015) Harper's Illustrated Biochemistry, 30<sup>th</sup> Edition, McGraw-Hill Medical.
3. Nelson DL and Cox MM. (2013) Lehninger Principles of Biochemistry, 6<sup>th</sup> Edition. WH Freeman.

M.Sc. (Sports Biochemistry) (Semester-III)  
(Credit Based Evaluation and Grading System)

**L T P**  
**4 0 0**

***SBP 510: PRACTICALS IN MICROBIOLOGY***

**Course Contents**

Preparation of solid media and liquid media, pour plating, streaking plate method, serial dilution, CFU count, staining techniques like simple staining, Gram's Staining, Differential staining, Motility test, Hanging drop, Bacterial transformation, plasmid isolation and purification, restriction digestion.

**Recommended Books:**

1. Basic Practical Microbiology. A manual. 2006 Society for General Microbiology. ISBN 0 95368 383 4  
Practical Microbiology. R.C. Dubey, D.K. Maheshwari. S Chand & Co Ltd; 5TH Edition (2010).

M.Sc. (Sports Biochemistry) (Semester-IV)  
(Credit Based Evaluation and Grading System)

**L T P**  
**4 0 0**

***SBL 551: MOLECULAR CELL BIOLOGY***

**Mid Semester Examination: 20% weightage**  
**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Section – A**

**Membrane Structure and Function:**

Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

**Section – B**

**Structural Organization and Function of Intracellular Organelles:**

Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

**Section – C**

**Cell Signaling:**

Hormones and their receptors, cell surface receptor, signaling through G- protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

**Section – D**

**Cellular Communication:** Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

M.Sc. (Sports Biochemistry) (Semester-IV)  
(Credit Based Evaluation and Grading System)

**Microscopic Techniques:** Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

**Recommended Books:**

1. Karp, G. (2013) Cell and Molecular Biology: Concepts and Experiments. 7th edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E.(2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Lodish, H., Berk, A. and 6 more. (2007) Molecular Cell Biology 6 th edition. W. H. Freeman.

M.Sc. (Sports Biochemistry) (Semester-IV)  
(Credit Based Evaluation and Grading System)

**L T P**  
**4 0 0**

***SBL552: MEDICAL BIOCHEMISTRY***

**Mid Semester Examination: 20% weightage**  
**End Semester Examination: 80% weightage**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**Course Contents**

**Section – A**

**Introduction:** Definition and scope of clinical biochemistry in diagnosis, use of clinical laboratory and interpretation of results

**Body Fluids:** Biochemistry of urine, blood and cerebrospinal fluid, normal and abnormal constituents and clinical entities in body fluids.

**Water and Electrolyte:** Distribution of water in body, water turnover and balance, electrolyte composition of body fluids, regulation of electrolyte balance

**Section – B**

**Acid Base Balance:** Production of acids and bases by the body, maintenance of body pH, disorders of acid base balance

**Disorders of carbohydrate metabolism:** Disorders of carbohydrate metabolism: Diabetes mellitus, ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia, lactose intolerance, and lactic acidosis. Disorders of lipids: lipid mal-absorption and steatorrhea, sphingolipidosis, clinical interrelationships of lipids, lipoproteins and apolipoproteins; Disorders of amino acid metabolism: inborn errors of amino acid metabolism-alkaptonuria, phenylketouria, albinism, gout, hyperglycemia, phenylalaninemia, homocystineuria, tyrosinemia, aminoacidurias; Disorders of nucleic acid metabolism (Purine and Pyrimidine metabolism); Disorders of iron, porphyrin and mineral metabolism; Metabolism under stress conditions.

**Section – C**

**Clinical Enzymology:** Principles of diagnostic enzymology, clinical significance of alkaline and acid phosphatase, SGOT, SGPT, LDH, CPK, aspartate aminotransferase, alanine aminotransferase, Creatine kinase.

**Hormonal Disturbances:** Hormones their mode of action and functions. Clinical aspects of protein hormones, anterior pituitary hormones, posterior pituitary hormones, steroid hormones, adrenocortical steroids and thyroid hormones.

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**Section – D**

**Detoxification:** Mechanism of detoxification: oxidation, reduction, hydrolysis and conjugation, clinical aspects of detoxification.

**Organ Function Tests:** Renal function test, liver function test, gastric function test and thyroid functions test.

**Recommended Books**

1. Palmer T and Bonner PL (2007) Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, 2<sup>nd</sup> Edition, Woodhead Publishing.
2. Vasudevan D, Sreeekumari S and Vaidyanathan K (2016) Textbook of Biochemistry for Medical Students. 8<sup>th</sup> Edition. Jaypee Brothers Medical Publishers (P) Ltd.

M.Sc. (Sports Biochemistry) (Semester-IV)  
(Credit Based Evaluation and Grading System)

**L T P**  
**4 0 0**

***SBP561: PRACTICALS IN CLINICAL BIOCHEMISTRY-II***

Preparation of buffer solutions, determination of pKa, pI and Measurement of absorption maxima. Demonstration of Beer-Lambert Law and study of its validation, Estimation of total and reducing sugars by spectroscopic methods, Isolation of glycogen, Acidic and enzymatic hydrolysis of polysaccharides, Measurement of optical rotation, Demonstration of phenomenon of inversion, Absorption maxima of aromatic amino acids, Estimation of protein by Biuret, Bradford, Lowry and UV methods. Demonstration of protein purification techniques. Paper chromatography of lipids and their characterization as saponification number, acid value and iodine number, Quantitative estimation of Vitamin C. Assay of enzymes of clinical importance like amylase, phosphatases and aminotransferases. Factors affecting enzyme activity. Estimation of Hb, serum cholesterol, creatine, uric acid, urea, triacylglycerides, HDL, LDL, bilirubin, blood sugar and serum electrolytes (Na<sup>+</sup>, K<sup>+</sup> and chloride) urine analysis for abnormal constituents.

**Recommended Books:**

1. Plummer D (2006) An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Co., New Delhi.
  2. Wilson K and Walker J (2010) Principles and Techniques of Practical Biochemistry, Cambridge University Press, UK.
- Boye R. (2006) Modern Experimental Biochemistry, Pearson Education, Asia, New Delhi.