FACULTY OF LIFE SCIENCES

Syllabus

For

M.Sc. BIOCHEMISTRY

(SPECIALIZATION IN SPORTS BIOCHEMISTRY)

(Credit Based Evaluation & Grading System)

(SEMESTER: I & II)

Examinations: 2019-20

Guru Nanak Dev University
Amritsar

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER SYSTEM)

SCHEME

Programme Code: BC(SSB)

Course #	C/E/I	Course Title	L	T	P	Total Credit
Semester I						
MBL-401	C	Biomolecules	4	0	0	4
MBL-402	C	Enzymology	4	0	0	4
MBL-403	C	Fundamentals of Molecular Biology	4	0	0	4
MTL-261	C	Biostatistics	3	1	0	4
CSL- 591	C	Computer Applications	3	0	0	3
MBP-422	C	Practicals in Basic and Clinical Biochemistry	0	0	6	6
						25
Semester II						
MBL-451	C	Concepts in Immunology	4	0	0	4
MBL-452	C	Metabolism of Carbohydrates and Lipids	4	0	0	4
MBL-454	C	Recombinant DNA Technology	4	0	0	4
	E	Elective-**I***	3	0	0	3
Outside course-**I**	I	Interdisciplinary Course-1**	4	0	0	4
MBP-471	C	Practicals in Molecular Biology	0	0	6	6
						25

*** The students are required to study any one of the following Elective papers**

MBL-582 Molecular Immunology
MBL-585 Environmental Biochemistry
MBL-586 Lipid Biochemistry
MBL-590 Medical Biochemistry
MBL-591 Applied and Medical Microbiology
MBL-592 Molecular Cell Biology
MBL-594 Human Physiology

**** Interdisciplinary courses 1 will be selected from schemes of courses of other Science Departments as decided by the BOC.**

NOTE: PSL-053 ID Course Human Rights & Constitutional Duties (Compulsory Paper) Students can opt. this paper in any odd semester. This ID Paper is one of the total ID Papers of this course.

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER-I)

Course No. MBL-401

BIOMOLECULES

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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:
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.

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 waal's, electrostatic, hydrogen bonding, Hydrophobic interactions. Stability of protein structure.

Section-D

Vitamins and Minerals: Definition, chemistry and functions of water and fat soluble vitamins, major trace minerals, their bound forms and functions. **Porphyrins:** Nucleus and classification of porphyrins, important metallo-porphyrins occurring in nature, chemical nature and physiological significance of bile pigment.

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, 4th Edition. John Wiley & Sons. New York.

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
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Course No. MBL-402

ENZYMOLOGY

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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 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.

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 GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co., New York.
2. Nelson DL and Cox MM. (2013) Lehninger Principles of Biochemistry, 6th Edition. Macmillan Worth Publishers, New Delhi.
3. Palmer T and Bonner PL (2007) Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, 2nd Edition, Woodhead Publishing.
4. Voet D, Voet JG and Pratt CW (2011). Fundamentals of Biochemistry, 5th Edition. John Wiley & Sons. New York.

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
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Course No. MBL-403

FUNDAMENTALS OF MOLECULAR BIOLOGY

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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

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 nuleotides,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 tRNAsynthetase, translational proof-reading, translational inhibitors, post- translational modification of proteins.

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.
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. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
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MTL-261-BIOSTATISTICS

Credit hrs.		
L	**T**	**P**
3	**1**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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.

Note:- The scope of this paper is restricted only to the applications of various statistical techniques. The mathematical derivations of various results are excluded.

Section-A

Statistical Methods — Collection of data, Frequency distribution and, Measures of Central Tendency, Dispersion.

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 definition of probability of an event, 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 Distributions: 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 pdfs only, Applications of these distributions in testing of hypothesis.

Section-D

Large sample test- Testing of significance of proportion in single population, Testing of equality of proportions in two populations, Testing of significance of mean in single population, Testing of equality of means in two populations.

Analysis of Variance — Meaning of analysis 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.

Text Books

1. Fowler, J., Cohen, L. and Jarvis, P. (1998). Practical Statistics for Field Biology. John Wiley and Sons, 2nd ed. [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)].
2. Raghavarao, D. (1983). Statistical Techniques in Agricultural and Biological Research Oxford and IBH Publishing Co. [Chapters: 2,3,4,5,7,8,9 and 10].

Reference Books:

1. Bland, M. (2006). An Introduction to Medical Statistics. Oxford University Press, 3rd ed.
2. Finney, D.J. (1980). Statistics for Biologists. Chapman and Hall Ltd.
3. Hoel, P.G. (1971). Elementary Statisitics. John Wiley and Sons, 3rd ed.
4. Ross, S.M. (2005). Introductory Statistics. Academic Press, 2nd ed.
5. Wayne, W, Daniel (1999). Biostatistics: A Foundation for Analysis in Health Sciences. John Wiley and Sons, 7th ed.
6. Woodworth, G. (2004). Biostatistics: A Bayesian Introduction. John Wiley and Sons.

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER-I)

Course No. CSL-591 : COMPUTER APPLICATIONS

Credit Hrs.		
L	T	P
3	0	0

Time: 3 Hours **Max. Marks: 100**

Mid Semester Marks : 20
End Semester Marks : 80

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, Internet basics and MS-Office 2003, Introduction to digital computers, Organization, Number system, I/O devices, Storage devices, Introduction to internet and its applications – www, email, ftp. MS-Windows basics, MS-Word – Meaning of Word–Processing, Creating, Saving, Printing documents, Formatting, Spell-Check, Adding page numbers, Header and Footer, Macros, Creating tables, Converting table to text and vice–versa, Mail Merge.

Section-B

MS-Excel – Spreadsheets, Using different types of formulae, Creating graphs and charts, Exporting charts to MS-Word, MS-PowerPoint – Creating presentations, Formatting, Adding effects and timings. Types of errors and level of significance, Tests of significance (F and t-test), Chi-square tests.

Section-C

Data analysis and database – Brief description and tabulation of data, Measure of central tendency and dispersion – Mean, Median, Mode, Range, Standard Deviation, Variance and Correlation coefficient using SPSS. Introduction to Data, Information, Database, DBMS (Advantages and disadvantages), Introduction to SQL (Data retrieval).

Section-D

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 EndNote.

Books Recommended:

1. Sinha, P.K. (1992). Computer Fundamentals.

2. Peter Norton's Introduction to Computers, 6th ed.

3. Windows Based Computer Courses, Sumit Kumar, JBD Publishers.

4. Gupta, S.C. (2004). Fundamentals of Statistics. Himalaya Publishing House.

Website Links

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.

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
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Course No. MBP-422

PRACTICALS IN BASIC AND CLINICAL BIOCHEMISTRY

Credit Hours		
L	**T**	**P**
0	**0**	**6**

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. Factors affecting enzyme activity, V_{max} and K_m Value. Enzyme activity studies, assay of enzymes of clinical importance like amylase, phosphatases and aminotransferases. Estimation of Hb, serum cholesterol, creatine, uric acid, urea, triacylglycerides, HDL, LDL, bilirubin, blood sugar and serum electrolytes (Na+, K+ 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. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER-II)

Course No. MBL-451

CONCEPTS IN IMMUNOLOGY

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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: Types of immunity, innate and adaptive immune system, Features of immune response: memory, specificity and recognition of self and non-self, terminology and approaches to the study of immune system.

Cells and Organs of the Immune System: Cells and molecules involved in innate and adaptive immunity, Toll-like receptors, Lymphoid cells, heterogeneity of lymphoid cells, T-cells, B-cells, Null cells, Monocytes, Polymorphs, Primary and secondary lymphoid organs-Thymus, Bursa of fabricius, spleen, lymph nodes, lymphatic system, mucosa associated lymphoid tissue (MALT), lymphocyte traffic, Activation of B and T cells and their differentiation.

Section-B

Humoral Immunity: Antigen-antibody interactions, primary and secondary immune modulation. Affinity and avidity, high and low affinity antibodies, immunoglobulins, classes and structure, complement fixing antibodies and complement cascade.

Cell Mediated Immunity:T-cell subsets and surface markers, T-dependent and T-independent antigens, recognition of antigens by T-cells and role of MHC in antigen processing and presentation, structure of T-cell antigen receptors, TCR, BCR, cell mediated effecter functions.

Section-C

Immunological Disorders: Inflammation, Types of hypersensitivity reactions, autoimmune disorders, their underlying molecular mechanism, etiology, diagnostic, prognostic and prophylactic aspects, immunodeficiency disorders: congenital and acquired, AIDS, immune response during bacterial (tuberculosis), parasitic (malaria), and viral (HIV) infections.

Section-D

Immunodiagnostic Procedures: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flowcytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH. Various types of immunodiffusion and immunoelectrophoreticprocedure, Immunoblot, agglutination of pathogenic bacteria, hemeagglutination and hemeagglutination inhibition, cellular techniques.

Recommended Books:

1. Kindt TJ, Osborne BA and Goldsby RA (2007) Immunology, 6th Edition, WH Freeman and Company, NY.
2. Owen JA, Punt J and Stranford SA (2013) Kuby Immunology, 7th Edition, WH Freeman and Company, NY.
3. Male D., Brostoff J., Roitt I and Roth D (2012) Immunology, WB Saunders Co. USA.
4. Parham P (2012). The Immune System, 3rd Edition, Garland Sciences, London and New York.

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER-II)

Course No. MBL-452

METABOLISM OF CARBOHYDRATES AND LIPIDS

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**

Mid Semester Marks : 20

End Semester Marks : 80

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 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. Basic principles of bioenergetics: chemical basis of large free energy of hydrolysis of some energetic compounds; coupled reactions; group transfer; biological energy transducers. Types of biological oxidation-reduction reactions.

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 disaccharides 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, 4th 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

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER-II)

Course No. MBL-454

RECOMBINANT DNA TECHNOLOGY

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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

Tools of Genetic Engineering: Enzymes used in recombinant DNA technology: restriction endonucleases & other DNA modifying enzymes, plasmid, bacteriophage and cosmids, BAC, YAC and yeast based vectors as vehicles of cloning, expression vectors.

Section-B

Cloning strategies: Cloning from mRNA & genomic DNA, gene libraries. **Selection of Recombinants:** Selection, screening and analysis of recombinants by genetic, immunological and nucleic acid hybridization methods. **Expression of recombinant DNA molecules:** Expression in bacterial, yeast, insect and mammalian cells.

Section-C

Basic Techniques: Isolation Handling and quantification of Nucleic acids, DNA (genomic & plasmid) & RNA, agarose gel electrophoresis, pulse field gel electrophoresis. Preparation of labeled DNA probes, Southern blotting.Northernblotting, DNA sequencing – Maxam Gilbert & Sanger Methods. DNA finger printing (RFLP, RAPD, AFLP), Polymerase chain reaction, site directed mutagenesis, Transformation, Transfection & generation of deletions, gene knock out.

Section-D

Applications of Recombinant DNA Technology: In Medicine: Molecular diagnostics, vaccines, drugs, gene therapy. In Agriculture: Transgenic plants, insecticide, herbicide resistant plants and antisense technology. **In Industry:** Commercially available recombinant products, transgenic animals.

Recommended Books:

1. Gene Cloning and DNA Analysis: An Introduction, 7th Edition. *T. A. Brown*. Wiley-Blackwell.

2.Principles of Gene Manipulation and Genomics, 7th Edition Sandy B. Primrose, Richard Twyman. Wiley-Blackwell.

Course No. MBP-471

PRACTICALS IN MOLECULAR BIOLOGY

Credit Hours		
L	**T**	**P**
0	**0**	**6**

Isolation of genomic DNA from human blood, Quantification of DNA using spectrophotometric method, Isolation of plasmid DNA from bacteria, ethanol precipitation of DNA, 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, Ligation of DNA fragments, Preparation of competent cells using CaCl2 method, Transformation of bacteria, Designing primers for PCR, Purification of a DNA fragment by agarose gel, RNA isolation, cDNA synthesis, protocol for quantitative PCR.

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. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER-II)

Course No. MBL-582

MOLECULAR IMMUNOLOGY

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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: An over view of the immune system, tools to study the immune system: Inbred stains, adoptive transfer systems, SCID Mice, ScID-Human Mice, primary lymphoid cultures, coloned lymphoid cell lines, hybrid lymphoid cell lines. **Antigens;** Antigenicity, immunogenicity, Antigenic determinants/epitopes, properties of B-Cell epitopes, properties of T-Cell epitopes, MHC-class-**II**-restricted antigens, mitogens, super antigens, vaccines.

Section-B

Antibodies: Structure and functions including molecular structure of antibodies; Immuno-globulin domains; Immunoglobulin fold; variable region domains; complementarity determining regions (CDRS), CDRS and antigen binding, hinge region. Engineered Monoclonal antibodies, antibody engineering and their clinical applications.**Antibody Diversity:** Models of antibody diversity, multigene organization of Ig genes; λ-chain multigene family, K-chain multigene family, Heavy chain multigene family, V-J rearrangements in light chain DNA, V-D-J rearrangement in heavy chain DNA, mechanisms of variable region DNA rearrangement; recombination signal sequences, Enzymatic joining of gene segments and role of RAG-1 and rag -2 genes; Molecular Mechanism of class switching.

Section-C

Molecular Organization of MHC: MHC molecules: MHC class-**I**, class-**II** and class-**III** genes in mouse and man, concept of MHC haplotypes. MHC molecules and genes; Organization of Class-**I** and class-**II** molecules; class-**I** MHC-peptide interaction; Class II MHC-peptide interaction; polymorphism of class I and class II molecules; class III molecules including heat shock proteins, MHC and infectious diseases. **T-Cell Receptor:** TCR for MHC-associated peptide antigen, structure of β and T-cell receptor CD3-TCR, Accessory molecules of T-cells, CD-28 and CTLA-4 as T-cell receptors for co-stimulators, integrins selectins.

Section-D

Signal Transduction and TCR-Complex: TCR clustering, recruitment and activation of protein tyrosine kinases and adapter proteins, Ras and Rac, calcineurin and protein kinase C signaling pathways in T-cell, transcription factors regulating gene expression, Costimulators and transduction pathways.

Signal Transduction and B-cell Receptor Complex: Structure of B-cell receptor complex, recognition of antigen by B-cell receptor and signal transduction, complement receptors and second signal for B-cell, Antibody response to T-dependent and T-independent antigens.

Recommended Books:

1. Owen JA, Punt J and stranford SA (2013) KubyImuunology, 7th Edition, WH Freeman and Company, NY.
2. Abbas AK, Lichtman AH, Pillai S (2015) Cellular and Molecular Immunology. 8th Edition WB Saunders Co. USA.
3. Parham P (2012) The Immune System, 3rd Edition, Garland Sciences, London and New York.

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER-II)

Course No. MBL-585

ENVIRONMENTAL BIOCHEMISTRY

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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

The Environment: Physical environment; biotic environment; biotic and abiotic interactions.
Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.**Population ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

Section-B

Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.**Community ecology:** Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

Section-C

Ecological succession: Types; mechanisms; changes involved in succession; concept of climax.**Ecosystem:** Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).**Biogeography:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

Section-D

Applied ecology: Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.**Conservation biology:** Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Books recommended:

1. Harrison, R.M. and de Mora, S.J. (1996). Introductory chemistry for the environmental sciences.
2. O'Neill, P. (1998) Environmental chemistry. Chapman and Hall, India.

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER-II)

Course No. MBL-586

LIPID BIOCHEMISTRY

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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: Nature of lipids; Medical and biological importance of lipids, an overview of structure and function of lipids and lipoproteins**.Metabolism of Lipids:**Digestion and absorption of lipids, transportation of lipids, role of apolipoprotiens in lipid transport.

Section-B

Lipids of Cellular Structure: Structure of membrane lipids; phosphoglycerides, sphingolipids, glycolipids, gangliosides and sterols, biosynthesis of structural lipids, function of structural lipids.

Section-C

Dietary Lipids: Role of dietary lipids, assimilation of lipid by body; lipids in growth and development, disorders in lipids metabolism.**Lipid Function:** Lipids as hormones and vitamins, structure and functions of eicosanoids, role of membrane lipids in adaptations, role of dolichol in glycosylation, lipids and membrane fusion, liposomes and drug delivery systems, role of lipids in signal transductions, immunity, lipids and skin diseases, lipid storage diseases.

Section-D

Techniques to Study Lipid Biochemistry: Extraction of lipids from natural samples, chromatographic techniques for purification and characterization of lipids.

Recommended Books:

1. Gurr, M.I, Harwood, J.L and Frayn, K.N. (2002): Lipid Biochemistry. Blackwell Science.
2. Vance, D. E and Vance, J.E. (Eds) (2008): Biochemistry of lipids, lipoproteins and membranes. 5th edition,Elsevier.

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER-II)

Course No MBL-590

MEDICAL BIOCHEMSITRY

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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

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, 2nd Edition, Woodhead Publishing.
2. Vasudevan D, Sreeekumari S and Vaidyanathan K (2016) Textbook of Biochemistry for Medical Students. 8th Edition. Jaypee Brothers Medical Publishers (P) Ltd.

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER-II)

Course N0. MBL-591

APPLIED AND MEDICAL MICROBIOLOGY

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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

Principles of classification of microbes; morphological, metabolic and molecular criteria for the classification, A brief introduction to major group of bacteria. Ultra-structure of bacteria.Microbial Cultivation, Growth curve and factors influencing growth. Nutritional types requirements of bacteria. Disinfection and sterilization: Staining characteristics and techniques. Serological characteristics, Bacterial respiration, Microbial Diversity.

Section-B

Food Microbiology: Microbiology of dairy industry and beverage fermentation. Role of microorganisms in beverages tea and coffee fermentations.Vinegar Fermentation, microbiology of wine industry.Genetically modified foods.Biosensors in food.

Section-C

Antibiotics and their Mechanism of action, Molecular principles of drug targeting.Bacterial resistance to antibiotics.New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines, Vaccine clinical trials.

Section-D

Medical Microbiology: Diseases caused by Gram positive bacteria, Diseases caused by Gram negative bacteria, Disease caused by toxigenic bacteria, Diseases caused by Gram negative bacteria of family Enterobacteriaceae, sexually transmitted diseases, Overview of medical mycology, Overview of medical parasitology.

Recommended Books:

1. Willey, J., Sherwood, L., Woolverton, C.. (2010).Prescott Microbiology.8th edition. Mc Graw Publication.
2. Pelczar, M. Jr., (2001) Microbiology. 5th edition. McGraw Hill Education.
3. Ananthanarayan and Paniker(2013) Textbook of Microbiology. 9th edition. Orient BlackSwan.
4. Goldman, E. and Green, L.H. (2015). Practical Handbook of Microbiology. 3rd Edition. CRC Press.
5. Pommerville, J C.(2013). Alcamo's Fundamentals of Microbiology. 10th edition. Jones & Bartlett Learning

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER-II)

Course No MBL-592

MOLECULAR CELL BIOLOGY

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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

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. **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-B

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-C

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.

Section-D

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. 7thedition.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 6thedition.W. H. Freeman

M.Sc. BIOCHEMISTRY (SPECIALIZATION IN SPORTS BIOCHEMISTRY)
(CREDIT BASED EVALUATION & GRADING SYSTEM) (SEMESTER-II)

Course No-MBL-594

HUMAN PHYSIOLOGY

Credit Hours		
L	**T**	**P**
4	**0**	**0**

Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

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: Human Physiology; Cells, Tissues, Organs and System Organization; Cell structure; Transport through Cell Membrane; Classification of Tissue; Homoeostasis; Role of organ and its system in regulation of homeostasis; Factors altering homeostasis**.**

Nervous System: Classification of nervous system (Central and peripheral); Structure and Function of neuron; ion channels; Role of action potential in neuro-transmission; Neurotransmitters and drug abuse

Muscular System: Structure and Types of muscles; Anatomy of muscle fibre; Muscle contraction; Muscle fibres; types and characteristics of muscle fibres including metabolism; Remodeling of muscle fibres for strength and conditioning; Muscle hypertrophy and atrophy; Muscle tone and fatigue.

SECTION-B

Respiratory Aspects of Exercise Physiology: Anatomy of respiratory system; Upper and lower respiratory tract; External, Internal and Cellular respiration; Pulmonary ventilation; Principles of gaseous 6 exchange – diffusion of oxygen and carbon-di-oxide from respiratory membrane; Transport of oxygen and carbon-di-oxide in the blood and body fluids.Regulation of respiration: Chemical control; Peripheral chemo receptors in the regulation of respiration.

Acute responses to exercise from rest to maximal chronic effects of endurance training, Respiratory changes during altitude change and environmental change.

Hypoxia and related changes of cellular and other physiological system.Training effect on respiration.

SECTION-C

Cardiovascular Aspects of Exercise Physiology: Chronic adaptations to endurance exercise training; various modes of training with respect to: Heart rate, Blood pressure, Stroke volume, Cardiac output, a-v-O2 difference. Vascularization and exercise training

Blood pressure responses to exercise, Determination of lactic acid and pyruvic acid in blood before and after exercise, Determination of Haemoglobin level before and after exercise, anaerobic power test (*Margaria* method).
Measurement of flexibility, agility, power and maximal work capacity, Determination of VO2 max by: Direct method, Queen's college step test, 12 min-run tests.

SECTION-D

Energy System: Human energy systems and energy metabolism during exercise. Anaerobic/ aerobic exercise; Adenosine triphosphate: energy currency. Phosphocreatine: energy reservoir and cellular oxidation.

Energy release from carbohydrate, protein and fat and metabolic mill.Energy transfer in fast and slow twitch muscle fibers.Oxygen uptake during recovery.

Recommended Books:

1. McArdle, W, Katch, F., and Katch, V. *Exercise Physiology: Energy, Nutrition, andHuman Performance*, Lippincott Williams & Wilkins.
2. Astrand, P, et al. Textbook of Work Physiology, 4th ed., Human Kinetics, 2003.