BIOCHEMISTRY
B. Sc. Semester Pattern Syllabus
B. Sc. Part I – Semester I
BIOCHEMISTRY
(With effect from academic session 2013-14)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carries 20 marks (each paper 10marks).

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
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2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
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3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) The B. Sc. Students of Biochemistry shall pay atleast one visit to any Biochemical / Research Institute as study tour during three-year degree course.
6) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
7) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.
8) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
9) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part I – Semester I - PAPER I
BIOMOLECULES & HUMAN PHYSIOLOGY

UNIT I:

Carbohydrates: Structure of monosaccharides, sterioisomerism and optical isomerism of sugars, reactions of aldehydes and ketone groups, ring structure and anomeric forms, mutarotation. Chemical reactions of sugars, important derivatives of monosaccharides, di- and tri-saccarides Structure, occurrence and biological importance of monosaccharides, oligosaccharides and polysaccharides, e.g. glycogen, Starch, cellulose, blood group polysaccharides, inulin, chitin, glycosaminoglycans.

UNIT II

Lipids: Definition and classification. Fatty acids: introduction, classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids. Triacylglycerols: nomenclature, physical properties, chemical properties and characterization of fats - hydrolysis, saponification value, acid value, rancidity of fats, Reichert-Meissel number and reaction of glycerol. Biological significance of fats. Glycerophospholipids (lecithins, lysolecithins, cephalins. phosphatidyl serine, phosphatidyl inositol, plasmalogens), sphingomyelins, glycolipids -cerebrosides, gangliosides.

UNIT III:

A) Muscles: Structure of striated muscle fiber. Molecular organization of contractile system, Sliding mechanism of muscle contraction, Neuromuscular Junction

B) Digestion. Digestion and absorption of carbohydrates, fats, proteins.

UNIT IV:

Membrane structure & transport: Membrane composition, Fluid mosaic model of Singer & Nicolson. Active & passive transport, Na-K pump, Calcium Pump

B. Sc. Part I – Semester I - PAPER II
(MICROBIOLOGY & VIROLOGY)

UNIT – I:

A) History & Development of microbiology: Controversy over spontaneous generation, Fermentation & Germ theory of diseases, Concept of immunization.

B) Microscopy: Compound Microscopy: Parts of Compound microscope, Numerical aperture & its importance, Resolving power, Importance of Oil immersion objective, Ray diagram of compound light microscope, Principles and applications of Dark field, Phase contrast, UV & Fluorescent microscopy. Electron microscopy: Principle and Ray diagram.

UNIT II:

A) Staining: Principle and technique of simple & differential staining (Gram, Acid-fast & Endospore staining).

B) Viruses: General characteristics of viruses. Virus Structure. Basis of Virus classification. Detailed study of Lytic cycle & Lysogeny.

UNIT – III:

A) Classification of Microorganisms: Prokaryotes and Eukaryotes, Haeckal system, Whittaker system, Bergey's Manual.

B) Bacteria: i) Bacterial morphology & subcellular structures (General morphology of bacteria, shapes & sizes). ii) Slime layer & capsule. iii) Cell wall structure of Gm +ve & Gm-ve cells iv) General account of Ribosome, Flagella & Fimbriae. v) Chromatin materials, plasmids and episomes. vi) Endospore: Detailed study of endospore structure & its formation, Basis of resistance.

UNIT IV:

Growth: i) Growth rate and generation time, ii) Details of growth curve & its various phases. Synchronous cultures: Selection by size, age & induction. Iii) Continuous cultures: Chemostat, Turbidostat & Dialysis techniques. iv) Measurement of growth: - Total cell count and viable cell count method. v) Physical conditions required for growth: - a) Temperature: - Classification of microorganisms on the basis of temp. requirements. b) Classification on the basis of gaseous requirements. c) Classification on the basis of hydrogen ion concentration

B. Sc. Part I Semester I
PRACTICALS

[A] Biomolecules

1) Qualitative analysis of Carbohydrates, Proteins, Urea, Creatinine, Cholesterol.
2) Colorimetric estimation of proteins by biuret method.
3) Extraction of total lipids by Folch Method.
4) Determination saponification value of fats.
5) Determination of Acid value of fats.
6) Preparation of starch from potato and its hydrolysis by salivary amylase.

[B] Microbiology

1) Demonstration, uses, & care of microbiological equipments.
2) Isolation of Bacteria on nutrient agar plate from water, air, skin, teeth samples etc.
3) Simple staining of Bacterial pure culture
4) Gram staining of bacterial pure culture.
5) Identification of spore producing capacity of bacterial pure culture & its comparison with any endospore-producing bacteria.
6) Bacterial capsule staining

7) Anaerobic culture of bacteria
8) Demonstration of starch hydrolysis by bacterial cultures.
9) Effect of osmotic pressure on bacterial growth.
10) Isolation of bacteriophage from sewage / other sources.

Note: - Mandatory to perform atleast 3 practical from each section

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Semester I

BOOKS FOR REFERENCE

1) Human Physiology, Vol. I & II, - C. C. Chatterjee – Medical Allied Agency – Calcutta.
2) Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
3) TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.
4) Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice Hall International Inc.
5) Biochemistry – Lehninger – CBS Publishers.
6) Biochemistry – Stryer – W. H. Freeman & Co. – New York.
7) Text Book of Biochemistry – West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt., Ltd.
8) General Microbiology, Vol. I & II – Powar, Daginawala – Himalaya Publishing House.
9) General Microbiology – Stanier, Adelberg, Ingraham – The Macmillan Press – London.
10) Fundamental Principals of Bacteriology – Salle – TMH Pub. Co. Ltd. – New Delhi.
11) Microbiology – Davis, Dulbacco, Eisen, Ginsberg – Harper International Edition.
12) Microbiology – Pelczar, Chan, Kreig –McGraw Hill Int. Edition.
13) Microbiology-An Introduction – Tortora, Funke, Case, Benjamin – Cummings Publ. Co.
14) Fundamental Virology (1995) – B. N. Fields, D. M. Knipe, P. M. Howley, R. M. Chanock, J. L. Meenick, T. P. Monath, Strans, Lippin Cott Raven.

BIOCHEMISTRY

B. Sc. Semester Pattern Syllabus

B. Sc. Part I – Semester II

BIOCHEMISTRY

(With effect from academic session 2013-14)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carries 20 marks (each paper 10marks)..

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
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2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
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3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) The B. Sc. Students of Biochemistry shall pay atleast one visit to any Biochemical / Research Institute as study tour during three-year degree course.
6) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.

7) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.
8) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
9) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part I – Semester II - PAPER I
HUMAN PHYSIOLOGY

UNIT I:

Excretion: - Structure of Nephron in brief. Mechanism of urine formation. (Glomerular filtration, Tubular reabsorption & Active secretion). Regulation of acid–base balance by the kidney. Brief idea of Juxtaglomerular apparatus.

Reproduction: Brief account of histological structure of Ovary & Testis. Structure & Functions of male & female sex hormones. Menstrual Cycle

UNIT II

Hematology: - Composition of blood, proteins in plasma & their functions, Coagulation of blood. Structure of hemoglobin and its functions, Mechanism of transport of O2 & CO2 by blood, Bohr's effect and chloride shift. Functions of RBCs, Fate of RBCs, Platelets & WBCs like Neutrophil, Eosinophil, Basophil, Lymphocytes (T & B) & Monocytes.

UNIT III:

Neurobiology: Structure of Neurons, Physiological properties of Nerve fibers, Detailed account of impulse generation (Membrane potential, its development, depolarization, depolarization) & conductivity (Transmission of impulse in myelinated and nonmyelinated nerve fiber). ii) Synapse and mechanism of synaptic transmission (Cholenergic and adrenergic transmission).

UNIT IV

Endocrines: -An overview of important endocrine glands & their hormones. Chemistry and classification of hormones. Role of Hypothalamus & Pituitary in hormone secretion. Storage, secretion and function of hormones (Thyroxine, parathormone, adrenaline, noradrenaline, insulin, glucagon, cortisol, Sex hormones). Concept of second messengers like cAMP, cGMP, Ca^{+2}, diacylglycerol and inositol-tri-phosphate. Basic mechanism of action of Peptide and Steroid hormones.

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B. Sc. Part I – Semester II - PAPER II
(MICROBIOLOGY & IMMUNOLOGY)

UNIT – I:

Nutrition: i) Basic nutritional requirements: ii) Nutritional classification of bacteria: Phototrophs & chemotrophs. iii) Pure cultures and methods of obtaining pure cultures.

UNIT II

Microbial control: i) Terminology: ii) Factors influencing antimicrobial activity. iii) Mechanism of cell injury iv) Physical control methods, v) Chemical control methods vi) Chemotherapeutic agents: - Sulphonamides and Antibiotics vii) Standardization of disinfectant: Phenol coefficient.

UNIT – III:

Immunology:

A) **The immune system**: - Active & Passive Immunity, Organ & cells of the immune system & their functions.
B) **Immunoglobulins:** - Nature & general properties of antibodies, Antibody reactions & antibody binding sites, Antibody specificity, Haptens, Basic structure of IgG, Brief account of other types of antibodies.

UNIT IV

Immunology:

A) Clonal selection theory. Brief idea of Hybridomas and monoclonal antibodies, Preparation and its application.

B) Brief idea of Complement system.
C) Brief account of cell mediated (Cellular) immunity & Humoral (Noncellular) immunity.

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B. Sc. Part I Semester II
PRACTICALS

[A] Physiology

1. RBC count
2. Measurement of blood pressure by sphygmomanometer.
3. Differential leucocyte count of blood.
4. WBC count.
5. Estimation of urine / serum creatinine
6. Estimation of urine / serum urea by diacetyl monoxime method
7. Assay of hemoglobin by hemoglobinometer.
8. Colorimetric estimation of blood/serum cholesterol.
9. ESR of blood.
10. Determination of clotting time of blood by capillary tube method.
11. Estimation of glucose by Benedict quantitative method.
12. Determination of bilirubin in serum

[B] Microbiology

13. Motility of given bacterial pure culture & its comparison with Lactobacillus / P. vulgaris.
14. Antibiotic sensitivity of bacterial pure culture.
15. Oligodynamic activity test of copper / metal.
16. Detection of coliforms in water.
17. Isolation of pure culture (any one or two bacteria from above sample) by pour plate method.
18. Isolation of pure culture by Streak plate method
19. Isolation of pure culture by spread plate method
20. To study the germicidal effect of UV light on bacterial growth.
21. Demonstration of effectiveness of alcohol as a disinfectant.
22. Detection of bacteria / fungi in spoiled food

[C] Immunology

23. Pregnancy test.
24. Ouchterlony immunodiffusion.
25. Demonstration of immunoelectrophoresis
26. Determination of blood groups (ABO & Rh system).

Note: - Mandatory to perform atleast 6 practicals, 3 from section A, 2 from section B and 1 from section C

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Semester II
BOOKS FOR REFERENCE

1) Human Physiology, Vol. I & II, - C. C. Chatterjee – Medical Allied Agency – Calcutta.
2) Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
3) TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.
4) Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice Hall International Inc.
5) Biochemistry – Lehninger – CBS Publishers.
6) Biochemistry – Stryer – W. H. Freeman & Co. – New York.
7) Text Book of Biochemistry – West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt., Ltd.
8) Immunology – Riott, Brastoff, Male – Mosby
9) Introduction to Immunology – Nandini Shetty.
10) Immunology – Janis Kuby. – W. H. Freeman and Co.
11) General Microbiology, Vol. I & II – Powar, Daginawala – Himalaya Publishing House.
12) General Microbiology – Stanier, Adelberg, Ingraham – The Macmillan Press – London.
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14) Microbiology – Davis, Dulbacco, Eisen, Ginsberg – Harper International Edition.
15) Microbiology – Pelczar, Chan, Kreig –McGraw Hill Int. Edition.
16) Microbiology-An Introduction – Tortora, Funke, Case, Benjamin – Cummings Publ. Co.
17) Outlines of Biochemistry – Conn & Stumpf.
18) The Experimental Foundations of Immunology – W. R. Clark.

B. Sc. Semester Pattern Syllabus
B. Sc. Part II – Semester III
BIOCHEMISTRY
(With effect from academic session 2014-15)

10) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carries 20 marks (each paper 10marks).

1) .

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
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2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
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	Total - 30 marks
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3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) The B. Sc. Students of Biochemistry shall pay atleast one visit to any Biochemical / Research Institute as study tour during three-year degree course.
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B. Sc. Part II – Semester III - PAPER - I
(MACROMOLECULES)

UNIT I:
Proteins: -

a) Quick review of amino acids, physico-chemical properties of amino acids (Solubility, Boiling & melting points, Reactions like Edman's, Sanger's, Dansyl chloride, Ninhydrin & Formaldehyde). Unusual amino acids.
b) Determination of primary structure of proteins
c) Peptide, peptide mapping, Merrifield-Gutt synthesis.

UNIT II:
Proteins: -

a) Secondary structure of proteins: - The α helix, β–pleated sheet structures.
b) Tertiary structure of proteins: Forces that stabilize the structure, Concept of domains, Protein denaturation.
c) Quaternary structure of proteins: Subunit interaction
d) Structure and biological functions of Collagen

UNIT-III:
Nucleic acids: -
a) Chemical structure & base composition of nucleic acids, Chargaff's rules.
b) Double helical structures, Watson - Crick Model (B-DNA), Deviations from Watson - Crick Model, Other DNA helices (A- & Z- DNA).
c) Forces stabilizing nucleic acid structures, Denaturation & renaturation, Sugar phosphate chain conformation, Base pairing, Base stacking, Hydrophobic and ionic interactions,

UNIT-IV:
Nucleic acids: -
a) Tm & buoyant density and their relationship with G-C content in DNA, Satellite DNA.
b) DNA sequencing: Maxam-Gilbert & Sanger's dideoxynucleotide sequencing.
c) Structure of m-RNA, r-RNA & t-RNA.

B. Sc. Part II – Semester III - PAPER – II
(BIOPHYSICAL TECHNIQUES I)

UNIT – I:
Spectrophotometry:-
a) Concepts of electromagnetic radiation's, Spectrum, Absorption of electromagnetic radiation's, Orbital theory, Concept of orbitals & their involvement in absorption of electromagnetic radiation's, Concept of chromophores, Beer's law – derivation & deviations, Extinction coefficient.
b) Instrumentation & applications of UV & Visible spectrophotometry.

UNIT II:
Spectrophotometry:-
a) Spectrofluorometry, Absorption & emission flame photometry.
b) **Buffers and pH:** Buffer capacity, Mechanism of buffer action, Henderson-Hasselbalch equation, Isoelectric pH, Biochemically & Physiologically important buffers. Titration curve of weak acids, Titration curve of amino acids. Electrometric determination of pH (Hydrogen, Calomel and combined glass electrode).

UNIT III:
Chromatography:-
a) Partition principle, partition coefficient, Nature of partition forces, Detailed account of Paper, Thin layer & Column chromatography (Column efficiency and concept of plates).
b) Gel filtration: - Concept of distribution coefficient, Types of gels & glass beads, Applications.

UNIT IV:
Chromatography:-
a) Ion-Exchange chromatography: - Principle, Types of resins, Choice of buffers, Applications.
b) Affinity chromatography: - Principle, Selection of ligand, Ligand attachment, Specific & non-specific elution, Applications.
c) Elements of High Pressure Liquid Chromatography & Gas Chromatography.

B. Sc. Part II Semester III
PRACTICALS

1) Quantitative estimation of amino acids using Ninhydrin reaction.
2) Estimation of DNA by diphenylamine reaction.
3) Estimation of RNA by orcinol reaction.
4) Determination of albumin and A / G ratio in serum.
5) The validity of Beer's law for colorimetric estimation of creatinine.
6) Estimation of blood glucose by Nelson-Somogyi method.
7) Estimation of blood sugar by Orthotoluidine method.
8) Determination of absorption maxima of hemoglobin.
9) Absorption spectrum of NAD and NADH
10) Separation of amino acids by two-dimensional TLC.
11) Separation of amino acids by descending\ascending paper chromatography.
12) Estimation of glycine by Sorenson's formol titration.

13) Preparation of standard buffers and determination of a pH of a solution.
14) Determination of pKa of weak acid by pH meter.
15) Determination of isoelectric pH of casein, egg albumin & BSA.
16) Titration of mixture of strong acid and weak acid.
17) Titration curves of amino acid/weak acids and determination of pK value.
18) Colorimetric estimation of calcium in serum.

Mandatory to perform atleast 6 practical

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Semester III
BOOKS FOR REFERENCE

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2) Biochemistry – Lehninger – CBS publishers.
3) Biochemistry – Stryer – W. H. Freeman & Co. – New York.
4) Textbook of Biochemistry – West, Todd, Bruggen, Mason – Amerind publishing Co. Pvt. Ltd.
5) Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay & Nath – Himalaya Publ. House.
6) A Biologists Guide to Principle & Techniques of Practical Biochemistry – Williams & Wilson – Edward Ernold Publ.
7) The Tools of Biochemistry – T. G. Cooper.
8) Principles & Techniques of Practical Biochemistry – Wilson, Walker- Cambridge Univ. Press.
9) Principles of Biochemistry – White, Handler, Smith – McGrew Hill Publ.
10) Biologist's Physical Chemistry – T. G. Morris.
11) Chromatography – G. Abbott.
12) Methods in Experimental Biology – R. Ralph.
13) Physical biochemistry – vanHolde – Prentice Hall Inc.
14) Physical Biochemistry – D. Friefelder – W. H. Freeman & Co.
15) Chromatography: A Lab Handbook of chromatographic and electrophorectic methods – Erich Heftman – Van Nostrand Reinhold, NY.
16) Immunology – Riott, Brastoff, Male – Mosby
17) Introduction to Immunology – Nandini Shetty.
18) Immunology – Janis Kuby. – W. H. Freeman and Co

B. Sc. Semester Pattern Syllabus
B. Sc. Part II – Semester IV
BIOCHEMISTRY
(With effect from academic session 2014-15)

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[A] Experiments,	20 marks
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B. Sc. Part II – Semester IV - PAPER - I
(ENZYMOLOGY)

UNIT - I:
a) History & Terminology
b) Classification & nomenclature of enzymes, Specificity of enzyme action (Lock & key model & Induced fit model).
c) Enzyme catalysis: Proximity & Orientation effect, covalent catalysis, acid-base catalysis, metal ion catalysis.
d) Regulatory enzymes: - Allosteric (ATCase) & covalently modulated (Glycogen phosphorylase) enzymes.

UNIT II:
a) Mechanism of action of Chymotrypsin and Ribonuclease.
b) Role of vitamins as coenzyme precursors (Riboflavin, Niacin, Pyridoxine, Biotin and Thiamine)
c) Effect of enzyme concentration, upward & downward curvatures with examples.
d) Effect of temperature on enzyme activity & temperature quotient.

UNIT-III:
Enzyme kinetics: Importance of measuring initial velocities, Derivation of Michaelis-Menten equation, Single & double reciprocal plots, Graphical representation of various inhibitors (Competitive, Noncompetitive & Uncompetitive) on Lineweaver-Burke plots. Importance of K_{cat} / K_{m}. Bisubstrate reactions – brief introduction to sequential and ping-pong mechanisms with examples.

UNIT IV
a) Effect of pH, General pH profile diagram with exceptions.
b) Concept of enzyme assay & its importance, Enzyme activity units (Katal & Specific activity)
c) Enzyme isolation and purification:- Enzyme solubilization, Brief idea of various fractionation procedures, Criteria for enzyme purity and homogeneity,

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B. Sc. Part II – Semester IV - PAPER – II
(BIOPHYSICAL & BIOCHEMICAL TECHNIQUES)

UNIT – I:
Electrophoresis:-
a) Migration of ions in electric field, Factors affecting electrophoretic mobility.
b) Paper electrophoresis: - Electrophoretic run, Detection techniques, Cellulose acetate electrophoresis, High voltage electrophoresis, Applications.
c) Gel electrophoresis: - Types of gels, Solubilizers, Procedure, Column & slab gels, Detection, Recovery & Estimation of macromolecules, Applications.

UNIT II
Electrophoresis:-
Disc-Gel electrophoresis: - Procedure & Applications.
a) SDS-PAGE Electrophoresis: - Isoelectric focussing, Principle, Establishing pH gradients, Stabilization against convection, Procedures & applications.

b) **Immunological techniques:** Immunodiffussion, Immunoelectrophoresis, Radioimmunoassay, ELISA and immunofluorescence.

UNIT – III:

Isotopic tracer technique: -

a) Radioactive & stable isotopes, Pattern and rate of radioactive decay. Units of radioactivity.
b) Measurement of radioactivity: - Geiger-Muller counter, Solid & Liquid scintillation counters (Basic principle, instrumentation & technique), Autoradiography. Cerenkov radiation. Brief idea of radiation dosimetry.
c) Measurement of stable isotopes by Mass Spectrometry
d) Isotopes commonly used in biochemical studies – ^{32}P, ^{35}S, ^{14}C, ^{3}H. Applications of isotopes in biochemistry, Principles of tracer techniques, Its advantages and limitations, Distribution studies, Isotope dilution technique, Metabolic studies, Clinical application.

UNIT IV

Centrifugation: -

a) Basic principles, Mathematics & theory (RCF, Sedimentation coefficient, Svedberg constant)
b) Types of centrifuge :- Desk top, High speed & Ultracentrifuges.
c) Preparative centrifugation: - Differential & density gradient centrifugation, Applications (Isolation of cell components).
d) Analytical centrifugation: - Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods.

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B. Sc. Part II Semester IV

PRACTICALS

1) Estimation of ascorbic acid by 2,6-dichlorophenol indophenol method
2) Isolation of casein by isoelectric precipitation method.
3) Estimation of proteins by Folin-Lowry's method.
4) Fractionation of proteins by ammonium sulphate and determination of its purity by PAGE electrophoresis.
5) To show using PAGE that commercially available BSA is not a homogeneous preparation.
6) SDS-PAGE of BSA & comparison of results with previous (PAGE) experiment.
7) Immobilization of enzymes / cells by entrapment in alginate gel.
8) Isolation of cell organelles by differential centrifugation
9) Assay of salivary amylase
10) Isolation of Urease and demonstration of its activity
11) Paper electrophoresis of serum proteins
12) Gel electrophoresis of serum proteins
13) Effect of pH on activity of enzyme
14) Effect of temperature on activity of enzyme
15) Demonstration of dialysis
16) Radial immunodiffusion.
17) Widal test
18) Demonstration of Salting-Out of proteins by ammonium sulphate precipitation.

Mandatory to perform atleast 6 practical

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Semester IV

BOOKS FOR REFERENCE

1) Biochemistry – Lehninger – CBS publishers.
2) Biochemistry – Stryer – W. H. Freeman & Co. – New York.
3) The nature of enzymology – Foster – Croom Helm, London.
4) Fundamentals of enzymology – Price & Stevens – Oxford Science Publ.
5) Principals of enzymology for food science – J. R. Whitkar – M. Dekker Publs.
6) Enzymes – Dixon & Webb – Academic press.
7) Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay & Nath – Himalaya Publ. House.
8) A Biologists Guide to Principle & Techniques of Practical Biochemistry – Williams & Wilson – Edward Ernold Publ.

9) The Tools of Biochemistry – T. G. Cooper.
10) Principles & Techniques of Practical Biochemistry – Wilson, Walker- Cambridge Univ. Press.
11) Outlines of Biochemistry – Conn & Stumpf.
12) Physical Biochemistry – H. B. Bull – John Wiley & Sons.
13) Enzyme Kinetics – Irwin H. Segal – Wiley Intersci. Publ.
14) Principles of Biochemistry – White, Handler, Smith – McGrew Hill Publ.
15) Biologist's Physical Chemistry – T. G. Morris.
16) Enzyme Kinetics – Paul Engel.
17) Enzyme Technology – Chaplin, Buche – Cambridge Univ. Press.
18) Chromatography – G. Abbott.
19) Methods in Experimental Biology – R. Ralph.
20) Physical biochemistry – vanHolde – Prentice Hall Inc.
21) Physical Biochemistry – D. Friefelder – W. H. Freeman & Co.

B. Sc. Semester Pattern Syllabus
B. Sc. Part III – Semester V
BIOCHEMISTRY
(With effect from academic session 2015-16)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carries 20 marks (each paper 10 marks).

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks
	Total - 150 marks

2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks
	Total - 30 marks

3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) The B. Sc. Students of Biochemistry shall pay at least one visit to any Biochemical / Research Institute as study tour during three-year degree course.
6) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
7) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.
8) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
9) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part III –Semester V - PAPER – I
(METABOLISM I)

UNIT – I:

Bioenergetics:

a) Concept of free energy, Entropy, Enthalpy & Redox Potential. Determination of $\Delta G^{0'}$ for a reaction.
b) High energy phosphate compounds (Ex. ATP, Phosphoenol pyruvate, Creatine phosphate etc.) – phosphate potential, Free energy of hydrolysis of ATP along with reasons for high $\Delta G^{0,}$. Other high energy compounds.
c) ATP-ADP Cycle, Energy charge (Phosphate potential) & its relation to metabolic regulation.

UNIT II

Techniques involved in metabolic studies: -

a) Studies with intact organisms, Excised organs, Organ slices, Isolated cells, Cell organelles & purified enzymes. Drawbacks & Advantages of each.
b) Studies with microorganisms & tissue culture, Advantages & disadvantages of each.
c) Clinical techniques employed in metabolic studies: Fistula, Catheterization & Organectomy.
d) Tracer studies, Inhibitors & mutation studies.

UNIT – III:

Carbohydrate metabolism: -

a) Detailed account of glycolysis with energy considerations & regulation, Entry of fructose, mannose & galactose in glycolysis, Cori cycle, Futile or substrate cycles in carbohydrate metabolism.
b) Glycogenolysis & Glycogenesis – Detailed account & hormonal control. Glycogen storage diseases.
c) Formation of acetyl CoA & detailed account of TCA Cycle, Isotopic tests of TCA cycle (Concept of Prochirality), Regulation, Amphibolic and anaplerotic nature of TCA cycle.

UNIT IV

Carbohydrate metabolism:-

a) Glyoxylate cycle and its role in conversion of fats into carbohydrates.
b) Gluconeogenesis– Detailed account of bypass reactions, Regulation, Malate & glycerophosphate shuttle system.
c) **Electron Transport chain-**Structure of mitochondria, oxidative and substrate level phosphorylation, Electron carriers of ETC, Incomplete reduction of oxygen (Cell injury – superoxide radicle), ATP Synthase (F1 F0 ATPase), Chemiosmotic hypothesis, Sites of ATP synthesis, Specific inhibitors and uncouplers of oxidative phosphorylation.

B. Sc. Part III – Semester V - PAPER – II
(MOLECULAR BIOLOGY)

UNIT –I:

DNA Replication in Prokaryotes: -

a) Basic Features of replication: Semiconservative nature of replication with experimental proof, Origin of replication, priming, 5'→3' direction of replication, Leading and lagging strand, bidirectional / unidirectional replication.
b) Different models of replication: Theta (θ) model, Rolling circle or sigma (σ) replication
c) Concept of Okazaki Fragment with experimental proof.
d) DNA replication in E. coli: Initiation, Elongation and Termination

UNIT –II:

DNA Replication in Prokaryotes: -

a) DNA Polymerases: Structure of polymerase I, Structure and properties of Klenow fragment, 5'->3' exonuclease activity, Nick translation, DNA polymerase III: Concept of holoenzyme, processivity, fidelity of replication. Other types of polymerases.
b) Regulation of E. coli Replication: concepts of C and D value.
c) DNA damage & repair: Ames test, types of DNA damage, Mismatch Repair (mut HLS system), Base Excision Repair, Nucleotide Excision Repair, Direct Repair, SOS or Error Prone repair.

UNIT – III:

Transcription: -

a. Basic features of RNA synthesis, Terminology, Prokaryotic RNA polymerases

b. Prokaryotic transcription: Initiation, elongation and termination with reference to Role of promoter, determination of length of promoter by DNA foot printing method. Conserved features of promoter. Weak and strong promoters, role of σ subunit, Different kinds of sigma subunits, Promoter binding and activation, RNA chain initiation and promoter escape, abortive initiation, rho dependent and independent termination of transcription.

UNIT – IV:

Transcription: -

a) Inhibitors of prokaryotic transcription: e.g. rifamycins.
b) Regulation of gene expression in prokaryotes: Lac Operon & Trp Operon
c) Reverse transcription.

B. Sc. Part III Semester V

PRACTICALS

1) To measure concentration of DNA & RNA by UV spectrophotometry.
2) Estimation of protein by Bradford method.
3) UV spectrophotometric estimation of a given protein by E 280\260 method.
4) Colorimetric estimation of inorganic phosphate in serum by Fiske-Subbarow method.
5) Isolation of glycogen from liver source and its estimation by anthrone method.
6) Determination of true glucose by Glucometer/Glucose oxidase method.
7) Determination of glucose by Folin-Wu method.
8) Effect of NaF on glycolysis in RBC by estimating glucose.
9) Determination of creatine & creatinine in urine.
10) Determination of serum acetylcholine esterase.
11) Screening test for glucose-6-phosphate dehydrogenase in RBCs.
12) Determination of serum pyruvate kinase.
13) Isolation of RNA from yeast

Mandatory to perform atleast 6 practical

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Semester V

BOOKS FOR REFERENCE

1) Harper's Biochemistry – Murray, Granner, Mayes, Rodwell – Prentice Hall International Inc.
2) Biochemistry – Lehninger – CBS Publishers.
3) Biochemistry – Stryer – W. H. Freeman & Co. New York.
4) Biochemistry – Geoffrey L. Zubay – McGraw Hill.
5) Biochemistry – J. David Rawn – Neil Patterson publs. NC.
6) Textbook of Biochemistry– West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt. Ltd.
7) Mol Bio (Fundamentals of molecular biology) – Upadhyay & Upadhyay, Himalaya Publishing House.
8) Molecular Biology – David Friefelder – Narosa Publishing House, New Delhi.
9) Cell Biology, Genetics, Molecular Biology, Evolution & Ecology – Verma, Agarwal – S. Chand & Co.
10) Molecular & Cell Biology – Bhamrah – Anmol Publ. Pvt. Ltd., New Delhi.
11) Molecular Biology of the Cell – Alberts, Bray, Lewis, Raff, Roberts, Watson – Garland Publishers, New York.
12) Molecular Biology of the gene – J. D. Watson, NH Hopkins, Roberts, Stertz, Weiner- Freeman.
13) Molecular Biology of the Gene – Watson, Hopkins, Roberts, Steitz, Weiner – Benjamin Cummings Publishing Co.
14) Molecular Cell Biology – Baltimore, Zipursky, Matsudaria, Darnel – W. H. Freeman & Co., New York.
15) Principles of Biochemistry – White, Handler, Smith – McGraw Hill Publ.

B. Sc. Semester Pattern Syllabus
B. Sc. Part III – Semester VI
BIOCHEMISTRY
(With effect from academic session 2015-16)

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B. Sc. Part III –Semester VI - PAPER – I
(METABOLISM II)

UNIT – I:
Lipid metabolism: -

a) Hydrolysis of triacylglycerols, transport of fatty acids into mitochondria (Carnitine), Detailed account of β-oxidation of fatty acids (β-oxidation in mitochondria and peroxisomes), Oxidation of unsaturated fatty acids & odd carbon fatty acids. α & ω–Oxidation- Brief idea. ATP yield from fatty acid oxidation. Regulation.
b) Detailed account of HMP Shunt & its significance in general, its connection to lipid metabolism.

UNIT – II:
Lipid metabolism: -

a) Ketogenesis, Ketosis & ketoacidosis in physiology & pathology.
b) Biosynthesis of fatty acids, Fatty acid synthase complex, Regulation, Microsomal & Mitochondrial system of chain elongation & synthesis of unsaturated fatty acids.
c) Biosynthesis of triglycerides & phospholipids (Phosphatidyl-ethanolamine, choline, inositol), sphingolipids.

UNIT – III:
Protein metabolism: -
a) Transamination.
b) Oxidative & Non-oxidative deamination.
c) Transport of ammonia (Carrier of ammonia – Glutamine, Alanine).
d) Urea cycle – Detailed account, Linkage of urea & TCA cycle, Compartmentation of urea cycle, Regulation, Metabolic disorders of Urea cycle, Treatment of disorder of urea cycle.
e) Transmethylation & Decarboxylation.
f) Metabolism of phenylalanine. Glycogenic and ketogenic amino acids.

UNIT IV
Nucleic acid metabolism: -
a) Biosynthesis of purine nucleotides & its regulation (De novo synthesis), Recycling of purine bases by salvage pathway using PRPP.
b) Catabolism of purine nucleotides, Gout.
c) Biosynthesis of pyrimidine nucleotides – De novo synthesis, its regulation & Salvage synthesis.
d) Catabolism of pyridimine nucleotides.
e) Ribonucleotides as precursors of deoxiribonucleotides (Ribonucleotide reductase & its regulation)
f) Concept of cyclic nucleotides in metabolism, cAMP.

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B. Sc. Part III – Semester VI - PAPER – II
(MOLECULAR BIOLOGY & rDNA TECHNOLOGY)

UNIT –I:
Genetic Code & Decoding System: -
a. **The Genetic Code**: Features of genetic code, Deciphering the genetic code, Wobble hypothesis,
b. **The decoding system: -** i) Aminoacyl synthatases, ii) Brief structure of t-RNA, iii) Attachment of amino acid to t-RNA, iv) Error correction in amino acylation.
c. Selection of initiation codon – (Shine-Dalgarno sequence).

UNIT II
Translation:
Protein synthesis- Initiation, Elongation & Termination (Ribosome structure, A and P sites, charged tRNA, f met tRNA, initiator codon, formation of 70S initiation complex, role of EF-Tu, EF-Ts, EF-G, and GTP. Release factors RF1 and RF2.

UNIT –III:
Basic Introduction to rDNA Technology
a. **Terminology**:
b. **Restriction endonucleases**: Rstriction-modification system, types of restriction enzymes, sticky and blunt ends.
c. **Joining DNA molecules**: joining blunt ended molecules, homopolymer tail joining, joining cohesive ends, use of T4 DNA ligase, use of linkers and adaptors.
d. **Vectors**: Plasmids – Characteristics of an Ideal Vector, Types of plasmids: pBR322 and pUC18. Lambda insertion and replacement vectors, cosmids, phagemids, Ti-plasmid. Concept of expression vectors. Features of expression vectors necessary for expression of heterologous genes. Shuttle vectors.

UNIT –III:
Basic Introduction to rDNA Technology
a) **Methods of transformation/transfection**: Calcium-phosphate precipitation, Electroporation,
b) **Selection**: selection by the use of antibiotic resistance, blue-white screening.
c) **Screening methods**: functional cloning or complementation, southern and northern blotting, colony lift screening, western blotting, immunological methods, screening through protein activity
d) **Genomic and cDNA libraries**: Method of generating genomic and cDNA library, comparison between the two types of libraries, Advantages and disadvantages of cDNA library.
e) **Polymerase chain reaction**: Detailed procedure of PCR, important considerations for primer designing, Salient applications of PCR.
f) **Applications of recombinant DNA technology**: Brief idea about recombinant DNA products in medicine (insulin, hGH), Recombinant vaccines, Gene therapy, DNA fingerprinting, Bt cotton, herbicide resistance.

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B. Sc. Part III Semester VI
PRACTICALS

1) Estimation of serum urea by diacetyl monoxime method.
2) Assay of activity of SGOT & SGPT.
3) Assay of activity of serum acid & alkaline phosphatase.
4) Inhibition of alkaline phosphatase activity by EDTA.
5) Assay of activity of papain.
6) Determination of serum phospholipids.
7) Determination of serum lipase.
8) Determination of serum isocitrate dehydrogenase.
9) Estimation of lipase by titrimetric method.
10) Demonstration of isolation of plasmid by alkaline lysis method.
11) Demonstration of isolation of genomic DNA.
12) Demonstration of Southern / western blotting.
13) Demonstration of replica plating technique.
14) Demonstration of restriction digestion
15) Identification of Lac+ bacteria by blue white screeing using IPTG
16) Determination of uric acid in urine
17) Determination of ketone bodies in urine
18) Determination of urinary ammonia

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Semester VI
BOOKS FOR REFERENCE

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2) Biochemistry – Lehninger – CBS Publishers.
3) Biochemistry – Stryer – W. H. Freeman & Co. New York.
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12) Molecular Biology of the gene – J. D. Watson, NH Hopkins, Roberts, Stertz, Weiner- Freeman.
13) Concepts in Biotechnology – Editors- Balasubramanian, Bryee, Dharmalingam, Green, Jayraman – Sangam Books.
14) Molecular Biology of the Gene – Watson, Hopkins, Roberts, Steitz, Weiner – Benjamin Cummings Publishing Co.
15) Molecular Cell Biology – Baltimore, Zipursky, Matsudaria, Darnel – W. H. Freeman & Co., New York.
16) Outlines of Biochemistry – Conn & Stumpf.
17) Principles of Biochemistry – White, Handler, Smith – McGraw Hill Publ.
18) Cell & Molecular Biology – Phillip Sheller – Wiley Publ.
19) Introduction to Modern Biochemistry – Karlson – Academic Press.