University of Rajasthan
Jaipur

SYLLABUS

M.Sc. Bio-Chemistry
(Annual Scheme)

2015-2017

Asstt. Registrar (Acad-I)
University of Rajasthan
JAIPUR
NOTICE

1. The Ordinance governing the examinations in the Faculties of Arts, Fine Arts, Social Sciences, Science, Commerce and Law are contained in a separate booklet. The students are advised to refer to the same.

2. Changes in Statutes/Ordinances/Rules/Regulations/Syllabi and Books may, from time to time, be made by amendment or re-making and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change.

3. All court cases shall be subject to the jurisdiction of the Rajasthan University headquarter at Jaipur only and not any other place.

Syllabus: M.Sc. Biochemistry

UNIVERSITY OF RAJASTHAN
JAIPUR- 302 004
(TWO YEAR COURSE-ANNUAL SYSTEM)
COURSE OUTLINE AND SCHEME OF EXAMINATION FOR
M.Sc. BIOCHEMISTRY

<table>
<thead>
<tr>
<th>Paper No.</th>
<th>Title of the Paper</th>
<th>Hours of Exam.</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-I</td>
<td>Cell Biology and Physiology</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>P-II</td>
<td>Chemistry of Biomolecules</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>P-III</td>
<td>General Metabolism</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>P-IV</td>
<td>Enzymology and Bioenergetics</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>P-V</td>
<td>Endocrine Biochemistry</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>P-VI</td>
<td>Biochemical techniques and</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Computational Methods</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lab Course

<table>
<thead>
<tr>
<th>Hours of Exam.</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>200</td>
</tr>
</tbody>
</table>

(Spread up in two days)

© University of Rajasthan, Jaipur
Published by Shiv Book Depot, Jaipur for University of Rajasthan
Printed by Harish Printers, Jaipur

Asstt. Registrar (Acad-I)
University of Rajasthan
JAIPUR
M.Sc. (Previous) BIOCHEMISTRY

PAPER-I: CELL BIOLOGY AND PHYSIOLOGY
UNIT-I CELL STRUCTURE AND COMPOSITION


UNIT-II WATER ELECTROLYTE AND ACID-BASE BALANCE

UNIT-III LIVER AND KIDNEY FUNCTIONS AND THEIR TESTS
Functions of liver, tests based on the secretory, excretory,
conjugation carbohydrates, protein and lipid metabolic functions
of liver. Formation of urine, physical characteristics, normal and
abnormal constituents of urine. Renal function test.

UNIT-IV BIOMEMBRANES
Composition and structure of cell membranes, Membrane lipids,
lipid bilayers. Membrane proteins—their location and function.
Sugar moieties of membranes, Glycoproteins and glycolipids,
Molecular models of cell membranes and liposomes. Membrane
fluidity and membrane fusion. Membrane asymmetry.
Reconstitution of functional membranes system from purified
components. The RBC membrane. Glycoporin. Transmembrane
hilices. Cell permeability and transport. Functions of Na⁺/K⁺ATP
ase and sodium transport. Transport proteins and carriers.
Compartmentation of cell by membranes.

UNIT-V TRANSPORT MECHANISMS
Transport across cell emembranes. Permeation at the expense of
kinetic energy. Metabolically coupled active transport. Bulk
transport by endocytosis, phagocytosis, phagotrophy, autorhoph,
pinocytosis and exocytosis. Adenyl cyclase, permease and other
membrane bound enzymes. Control of membrane fluidity. Action
potentials of cells. Nature of nerve impulse. Metabolism of nerve
cells at rest and in activity. Action potentials in the muscle fibres
and in excitable plant cells. Development, propagation and
transmission of action potential across the synapsis and the
neuromuscular junctions. Contractility and its chemical basis.
Structural proteins of muscle cells and their organization. The
sliding mechanism of muscle contraction. Role of calcium ions in
muscle contraction.

PAPER-II : CHEMISTRY OF BIOMOLECULES
UNIT-I CHEMISTRY OF CARBOHYDRATES
Chemistry and classification of carbohydrates. Monosaccharides,
disaccharides and oligosaccharides. Stability and formation of
Storage and structural polysaccharides and Glycosaminoglycans
(heparin, hyaluronic acid and others) Structural determination of
polysaccharides, glycoproteins and glycolipids. Blood group
substances. Acid-mucopolysaccharides and proteoglycans.

UNIT-II LIPIDS
The molecular structure and behaviour of lipids. Classification of
lipids. Chemistry of fatty acids, triacyl glycerols, waxes, glycerol
phospholipids, sphingolipids, glycosphingolipids, ceramides, cholesterol.
Bile acids and bile salts. Biological role of neutral
fats, phospholipids, cholesterol. Structure and biological role of
lipoproteins. Liposomes. Structure and functions of prostaglandins,
prostancilins, leukotrienes.

UNIT-III PORPHYRINS AND VITAMINS
Structure and functions, porphyrins heme and chlorophyll.
Vitamins—Discovery and importance of vitamins. Classification,
chemistry. Biological role and deficiency disorders of vitamins.

UNIT-IV CHEMISTRY OF AMINO ACIDS AND PROTEINS,
STRUCTURE AND CONFORMATION
Introduction to proteins, chemistry and properties of the amino
acids, properties of amino acid side chains, modified and unusual
amino acids. Peptides and the peptide bond, stability and formation
of the peptide bond. Proteins—structure and classification.
Introduction to chemical modification of proteins. Isolation,
purification and criteria of proteins. Peptide synthesis—solution
and solid phase methods.
Amino acid analysis of proteins. Primary structure, determination
of the N and C terminal residues of a protein, sequence
determination of a protein. Secondary structure—peptide foldings,
peptide mapping. Ramachandran plots. Fibrous proteins—keratins,
Myoglobin, hemoglobin and Rnase—structural features. Quaternary
structure of proteins. Determination of molecular weights and
number of sub units in a protein.

UNIT-V NUCLEIC ACIDS-I
Chemistry of Nucleic acids. Structure and properties of purines,
pyrimidines, nucleosides and nucleotides. Nomenclature for base
derivatives and polynucleotides. Structure of nucleic acids. Ribo
and deoxyribonucleic acids. Base composition, helical molecules,

PAPER-III: GENERAL METABOLISM

UNIT-I CARBOHYDRATE METABOLISM-I

UNIT-II CARBOHYDRATE METABOLISM-II

UNIT-III LIPID METABOLISM-I

UNIT-IV LIPID METABOLISM-II

UNIT-V AMINO ACID AND NUCLEOTIDE METABOLISM

PAPER-IV ENZYMENLOGY AND BIOENERGETICS

UNIT-I BIOCATALYSIS
Introduction to enzymology, nomenclature and classification of enzymes, properties of enzymes, enzyme assay and units of activity. Isolation and purification of enzymes. Factors affecting the rate of enzyme catalyzed reactions. Isozymes andzymogens. Enzyme inhibitors. Feed-back inhibition and regression. Allosteric inhibition catalytic RNA.

UNIT-II ENZYME KINETICS
Chemical kinetics, Michaelis-Menten and Briggs-Haldane kinetics. Determination of $K_m$. Analysis of kinetic data. Importance of
K_m, K_i, and V_max coenzymes and their role in metabolism. Reversible reactions.

UNIT-III ENZYMEOLOGY

UNIT-IV ENZYMEOLOGY-II

UNIT-V BIOENERGETICS AND PHOTOSYNTHESIS


PAPER-V : ENDOCRINE BIOCHEMISTRY
UNIT-I ENDOCRINE SYSTEM

UNIT-II HYPOPHYSIS, HYPOTHALAMUS AND RELATIONSHIP, PINEAL

UNIT-III THYROID, PARATHYROID, THYMUS AND OTHER GLANDS
Biosynthesis, regulation chemistry and functions of thyroid hormones. Hormones that regulate Ca^{2+} and phosphate metabolism. Parathyroid and calcitrol hormones, calcitonin. Chemistry, biosynthesis, regulation and functions of thymus, Melatonin endocrine role of kidney, Mechanism of erythropoietin, gastrointestinal hormones.

UNIT-IV PANCREAS AND ADRENALS

UNIT-V GONADS AND REPRODUCTION

PAPER-VI : BIOCHEMICAL TECHNIQUES AND COMPUTATIONAL METHODS
UNIT-I SPECTRO-PHOTOMETRY AND CHROMATOGRAPHY
Basic principles and applications of UV, IR, ESR, NMR and mass spectroscopy. Chromatography, Principles and partition, Paper and thin layer chromatography, Ionexchange chromatography, Gel permeation chromatography, GC and HPLC.

UNIT-II METABOLIC TECHNIQUES

UNIT-III RADIOACTIVITY

UNIT-IV ELECTROPHORESIS AND MICROSCOPY

UNIT-V STATISTICS AND COMPUTER SCIENCE

Syllabus : M.Sc. Biochemistry
Elements of computer science, general awareness of development of computers, Mainframe, mines, micro’s and super computer systems. CPU and peripherals I/O auxiliary storages. Software and programming languages: (Machine, assembly and higher level) popular software packages for use in biology. Networking concepts and its use in data search.

LAB COURSE-I
A. BASIC BIOCHEMICAL METHODS


4. Thin layer chromatography. Separation of lipids, purines, pyrimidines and their quantitation. Ion exchange chromatography. Quantitative separation of amino acids, nucleosides using Dowex 1 and Dowex 50 resins. Gel filtration; Separation of blue dextran and cobalt chloride on Sephadex G25 or similar experiment.

B. CLINICAL BIOCHEMISTRY


LAB COURSE-II

A. ANALYTICAL METHODS

1. Preparation of buffers.


B. CARBOHYDRATE AND LIPID ANALYSIS

1. Isolation of glycogen from liver. End group analysis by periodate oxidation and determination of average chain length of glycogen.


3. Extraction and adsorption column chromatography of plant pigments. TLC and GC analysis of lipids. Determination of iodine number, saponification and acid value of a fat.


M.Sc. (Final) BIOCHEMISTRY

PAPER-VII : BIOCHEMICAL GENETICS AND DNA REPLICATION

UNIT-I HERIDITY AND GENETIC ANALYSIS


UNIT-II GENOME ORGANIZATION


UNIT-III MUTATIONS, RECOMBINATION AND GENE TRANSFER

UNIT-IV DNA REPLICATION-I

UNIT-V DNA REPLICATION-II AND REPAIR

PAPER-VIII : PROTEIN SYNTHESIS AND REGULATION

UNIT-I TRANSCRIPTION


UNIT-II TRANSLATION

UNIT-III REGULATION OF GENE EXPRESSION


UNIT-IV PROTEIN TARGETTING

UNIT-V SIGNAL TRANSDUCTION
SYLLABUS: M.Sc. Biochemistry

UNIT-V PLANT AND ANIMAL VIRUSES
General features: Host-virus interactions, permissive/nonpermissive hosts, structure of naked and enveloped viruses, cytopathic effects, assay methods (Pock assay, haemagglutination assay, transformation assay) and purification methods (ultrafiltration, ultracentrifugation and affinity methods).

UNIT-X IMMUNOLOGY

UNIT-I BASIC IMMUNOLOGY

UNIT-II APPLIED IMMUNOLOGY-I
Hybridoma technique and monoclonal antibodies. Antigen-antibody interactions. Immuno-analytical methods based on Ag-Ab interactions (Gel diffusion techniques, immunoelectrophoresis, immunofluorescence, RIA, ELISA and western blotting). Vaccines. Methods of vaccine production. DNA vaccines, synthetic vaccines.

UNIT-III APPLIED IMMUNOLOGY-II

UNIT-IV IMMUINO ANALYTICAL METHODS
Production and immuno technology and purification of polyclonal antibodies. Antigen-antibody interactions-gel diffusion, immuno electrophoresis, immuno fluorescence, RIA, ELISA Western blotting and FACS techniques. Vaccines-types and their applications. (DNA, recombinant DNA, peptide and antitypic vaccines).
UNIT-V CYTOKINES
Effector molecules, cytokine receptors. Complement, classical
and alternate pathways of complement activation, regulation of
complement activation pathways. Immunological tolerance,
hypersensitivity, Autoimmunity, immunology in cancer and AIDS,
Vaccines.

PAPER-XI BIO TECHNOLOGY
UNIT-I PROTEIN ENGINEERING
Immobilized enzymes and cells. Methods of immobilization and
applications. Resolution of amino acid recombines. Synthesis of
improved penicillin's increased protein stability and enhanced
specific activity. Altering the kinetic properties and pH.

UNIT-II MICROBIAL BIOTECHNOLOGY
Introduction to microbial biotechnology. Large-scale cultivation
of microbes, problem of oxygen supply, basic fermenter design,
current design of stirred tank reactor, aseptic operation, control
systems, batch versus continuous operation, down-stream
processing. Production of biomass (microbial insecticides, starter
cultures, single cell proteins production). Production of low
molecular weight compounds—primary and secondary metabolites.
Metabolic end products. Bioconversions. Microbial polysaccharides
and production of microbial enzymes. Microbiological mining.
Introduction to drug design and delivery.

UNIT-III ANIMAL BIOTECHNOLOGY
Introduction to animal biotechnology. Cells and cell lines, media
for cell structure and equipment. Production of viral vaccines.
Production of high value therapeutics interferon and plasminogen
activator, urokinase. Monoclonal antibodies. Immuno toxins as
therapeutic agents. Chimic antibodies. Introduction to transgenic
knockouts.

UNIT-IV PLANT BIOTECHNOLOGY
Introduction to plant biotechnology. Plant cell culture, plant
protoplast and protoplast fusion. plant viruses as vectors. Ti
plasmid as vector and transgenic plants. Transgenic technology.
Antisense RNA and DNA.

UNIT-V MICROBIAL PATHOGENS AND
ANTIMICROBIAL AGENTS-II
Antibiotics: Assay of antibiotics, chemistry and biosynthesis of
important antibiotic compounds. First, second, third and fourth
generation antibiotics with reference to modified penicillins.
Antibiotic resistance. Biochemical modes of action of antibiotics
acting as inhibitors of ribosomal function (e.g., aminoglycosides,
tetracyclines, puromycin, chloramphenicol etc.) inhibitors of nucleic
acid metabolism, actinomycin D, mitomycin C etc.) inhibitors of
cell wall biosynthesis (penicillins, bacitracins etc.) and inhibitory
of membrane function (polyenes, peptide antibiotics etc.)

PAPER-XII GENETIC ENGINEERING
UNIT-I GENETIC ENGINEERING-I
Introduction and overview of methodology for cloning. Homologous and heterologous expression of genes. Methods of
ligation. DNA ligases, ligation of fragments with cohesive ends.
Use of restriction nucleases in cloning. Use of viral and plasmids
YAC, shuttle vectors. Eucaryotic vectors. Copy number
subcloning strategies.

UNIT-II GENETIC ENGINEERING-II
Identification of clones of interest. The use of genomic DNA
library and DNA library in gene cloning. Chromosome walking
and mapping techniques. Use of expression vectors to over
produce proteins. Baculoviral expression. Reporters genes and
identification of upstream control elements. Secretion of
recombinant proteins. Fusion proteins. Yeast expression. Site
directed mutagenesis. Subtractive cDNA cloning. Phage display of
proteins and peptides. 2-hybrid system.

UNIT-III DNA CLONING, TOOLS AND TECHNIQUES
Production of recombinant proteins with examples of insulin,
somatostatin and interferon. PCR and its applications. RFLP and
its applications. DNA finger printing, trans genics and cloning
techniques.
DNA Sequencing methods. Maxam and Gilbert's method. Dideoxy
chain termination method of Sanger. Gene probes in detection
prenatal and antenatal detection of disease. Human genome
project.
UNIT-IV GENE REGULATION AND HUMAN DISEASE
Oncogenesis with reference to protooncogenes. Transcription
factors as oncogenesis (Fos, Jun, AP, 1, V erb A and thyroid

UNIT-V REGULATION OF GENE EXPRESSION IN
PROKARYOTES AND EUKARYOTES
Negative and positive control of gene expression (Lac operon).
Dual promoters (Gal operon). Dual function of repressor (ara
operon). Transcriptional control by attenuation (trp operon). Phase
variation (Salmonella flagellar protein synthesis). Translational
feedback.

LAB COURSE-I

A. ANALYSIS OF BIOMOLECULES
1. Absorption spectra of nucleic acids and base derivatives.
Preparation and quantitation of nucleic acids. Analysis of nucleic
acids for base composition and GC content.
2. Hyperchromicity. Correlation of \( T_m \) and base composition.
Incorporation of \( ^1H \) thymidine into DNA. Plasmid mini
preparations.
3. Large scale isolation of a plasmid DNA. Use of restriction
endonucleases and ligase. Agarose gel electrophoresis.
4. Insertion of foreign DNA into a vector and transformation. Blot
analysis for RNA and DNA. DNA sequencing by Sanger’s
method (demonstration).

B. ENZYME KINETICS AND IMMUNOLOGY
1. Determination of blood groups. Ouchterlony double immuno
diffusion.
2. Immuno electrophoresis. RIA and ELISA methods
(demonstrations).
of mitochondria. Intracellular localization of dehydrogenases and
respiratory enzymes. Preparation of chloroplasts and nuclei.
Isolation and purification of enzymes (lysozyme from egg white,
urease from jack bean meal, arginase from liver, pyrophosphatase
from yeast).
4. Kinetic studies including determination of \( K_m \) and \( K_I \).
Metal ion activation of enzymes. Determination of activation energy of an
enzyme. Turnover number of catalase or trypsin. Enzyme inhibition.

M.Sc. BIOCHEMISTRY
(Previous and Final)
Instructions to examiners to all theory papers.
Max. Marks of each theory paper is : 100
Time : 3hrs.

Note:
1. Ten questions will be set in all selecting two questions from each
unit.
2. Candidates have to attend five questions, one from each unit.
M.Sc. BIOCHEMISTRY
(Previous and Final)

Max. Marks : 200

Duration of Exam : 12 hrs.
(Spread in 2 days)

4 Exercises to be performed selecting one exercise from each section.

Two quantitative exercises  = 50×2 = 100
Two qualitative exercises  = 25×2 = 50
Viva = 30
Record = 20

= 200

Note— The practical examination will be conducted by the board of two external and one internal examiners who will conduct practical on both days.