UTTARKHAND TECHNICAL UNIVERSITY
DEHRADUN

SYLLABUS
w.e.f. 2010 - 11

MASTER OF SCIENCE
IN
BIOCHEMISTRY
COURSE STRUCTURE & ORDINANCES FOR
M.Sc. BIOCHEMISTRY

1. Course duration: Four semester (two years)
2. Objectives and Rules: Four semesters (two years) M.Sc. Programme is formulated for developing competent Biochemists, who are confident enough to take up various jobs. The course is based on interdisciplinary nature of Biochemistry, Chemistry, Quantitative Biology, Genetics, Microbiology and Biophysics. The programme obliges students to read original publications and envisages significant inputs in laboratory work, communication skill, creativity, planning, execution and critical evaluation of the scientific data. The specializations introduced in the four semester course of Biochemistry are: Organic Chemistry, Biomolecules, Metabolism-I, Enzymology, Methods in Biochemistry, Molecular biology – I, Cell Biology & Physiology, Metabolism-II, Plant Biochemistry, Microbial Biochemistry, Molecular biology – II, Clinical Biochemistry, Immunology, Nutritional Biochemistry, Bio membranes, Biostatistics & Bioinformatics.

3. Eligibility for admission: Graduates in Biochemistry, Chemistry, Microbiology, Life Sciences and Medical Sciences as principal subject or Biochemistry as subsidiary subject are eligible for admission to the course.

4. Marks requirement: Minimum 55% of aggregate (General Category), Minimum 50% of aggregate (SC, ST Category) or as per University / Government norms.

5. There shall be five theory papers (Paper I, II, III, IV & V), two lab. Courses (Paper VI & VII) and a seminar & internal assessment in M.Sc. First semester.

6. There shall be five theory papers (Paper VIII, IX, X, XI & XII), two lab. Courses (Paper XIII & XIV) and a seminar & internal assessment in M.Sc. Second semester.

7. There shall be five theory papers (Paper XV, XVI, XVII, XVIII & XIX), two lab. Courses (Paper XX & XXI) and a seminar & internal assessment in M.Sc. Third semester.

8. There shall be one theory papers (Paper XXII), a dissertation (Paper XXIII), a seminar & internal assessment in M.Sc. Fourth Semester.

9. Student will be assigned dissertation under the supervision of a competent faculty member (having Ph.D. degree) of the Institute in the fourth semester at the beginning of the semester which will continue till the end of the session. In some special cases where the department decides then a major topic may be assigned for maximum two students for dissertation work. The dissertation work will be evaluated by the examiners appointed by the University.

10. Evaluation of seminar will be done as per given Performa. Evaluation of seminar will be done separately by individual teachers & average of all the assessment by all the teachers will be considered as final marks. Dissertation will be evaluated on the basis of Thesis Writing, Presentation & Defense.

11. The minimum passing marks shall be 50% in aggregate and 40% in each individual paper of theory, practical, seminar & internal assessment and dissertation / project work.
8 The division shall be determined on the basis of aggregate marks of all the papers (theory, practical, seminar, internal assessment and dissertation / project work) of both previous and final year prescribed for the degree.

9 Conduct of examination and award of division will be as per following:
   a) First division 60% and above
   b) Second division 48% and above but less than 60%
   c) Third division 40% and above but less than 48%

10 The details of papers and scheme of examination is given on following pages.

UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN
(UTTARAKHAND)

CURRICULUM FOR M. Sc. BIOCHEMISTRY
(TWO YEAR (FOUR SEMESTER) COURSE)

SEMESTER SYSTEM

SCHEME OF EXAMINATION

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Paper No.</th>
<th>Paper Code</th>
<th>Nomenclature</th>
<th>Periods / Weeks</th>
<th>Max. Marks (70 + 30 = 100)</th>
<th>Credits</th>
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<td>4</td>
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Seminar & Internal Assessment : 20 + 30 (10 + 10 + 10) = 50
(Attendance, Practical & overall performance)
Total marks of M. Sc. First Semester = 750
### M. Sc. SECOND SEMESTER

<table>
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<th>S. No.</th>
<th>Paper No.</th>
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Seminar & Internal Assessment : 20 + 30 (10 + 10 + 10) = 50  
(Attendance, Practical & overall performance)  
Total marks of M. Sc. Second Semester = 750

### M. Sc. THIRD SEMESTER

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<th>S. No.</th>
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Seminar & Internal Assessment : 20 + 30 (10 + 10 + 10) = 50  
(Attendance, Practical & overall performance)  
Total marks of M. Sc. Third Semester = 750
## M.Sc. FOURTH SEMESTER

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<th>S. No.</th>
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Seminar & Internal Assessment: 20 + 30 (10 + 10 + 10) = 50
(Attendance, Practical & overall performance)
Total marks of M. Sc. Fourth Semester = 350

Grand Total Marks: Total Marks of M. Sc. Semester I + II +III+IV= Total Marks of M. Sc. Final = 750 + 750 + 750 + 350 = 2600

Dissertation: Two periods (equivalent to theory) per week per student
CERTIFICATE
(To be used in Dissertation Thesis)

This is to certify that the Dissertation entitled “…………………………”. Submitted by ………………. Enrollment no. …………… University roll no.………….. in partial fulfillment of the degree of Master of Science in Biochemistry (Name of the Institute) of Uttarakhand Technical University, Dehradun, Uttarakhand is a bonafide and original research work carried out by her/him under my / our supervision and guidance during the academic year …………. No part of this dissertation has been submitted to any other university for any other degree or diploma.

SUPERVISOR

DEPARTMENT OF BIOCHEMISTRY
SEMINAR ASSESSMENT FORMAT

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Remarks (if any):
Date:------------------------

(Name & Sig. of Teacher)
DETAILED SYLLABUS

M. Sc. BIOCHEMISTRY (FIRST SEMESTER)
Paper - I: ORGANIC & BIO-PHYSICAL CHEMISTRY (Code - MBC 111)

MAX. MARKS: 70     TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attempt Question No. 1 & five more selecting one question from each Unit. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

UNIT – I

Organic Chemistry & Reaction Mechanisms: The hydrogen bond and hydrophobic interactions. Reactive intermediates formation, structure, stability and reactions of carbonium ions, carbanions. Free radicals in biological systems, oxygen as free radical in auto-oxidation of fats, free radical inhibitors in the cells like vitamin E, vitamin A, vitamin C.

UNIT – II

Types of reactions catalyzed by enzymes: Nucleophilic displacement reactions, displacement reactions of carbonyl groups, displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic reactions, conjugative elimination, enolic intermediates in isomerization reactions, beta cleavage and condensations, some isomerization and rearrangement reactions.

UNIT – III

Stereo chemistry: Structural isomerism, stereoisomerism, geometrical isomerism ( E & Z nomenclature ) Optical isomerism, optical activity and chirality, the chiral centre, enantiomers, configuration, specification, of configuration, DL, RS threo and erythro notations, sequence rules, stereoselective and stereospecific reactions, enantiotopic and diastereotopic ligands and faces.

UNIT – IV

Isotopic tracer techniques: Types of radiation, measurement, scintillation & gamma counters. Back ground noise quenching, applications. Autoradiography.
UNIT – V

Molecular spectroscopy: Basic concepts & applications of IR, 1H - NMR, Mass ORD, CD, X - ray diffraction & crystallography.

Suggested Reading:

M. Sc. BIOCHEMISTRY (First Semester)
Paper -II: BIOMOLECULES (Code – MBC 112)

MAX. MARKS: 70 TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type
   covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions
   from each Unit I, II, III, IV & V. The candidates shall be required to attempt
   Question No. 1 & five more selecting one question from each Unit.
   As far as possible, the questions shall be short answer type and not essay
   type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of
   marks will be indicated part - wise.

UNIT – I
Carbohydrates: Structures and properties of monosaccharides. Anomeric forms and
derivatives of monosaccharides (reactions of carbohydrates), Glycosidic bonds,
Biological importance of monosaccharides, disaccharides, trisaccharides and
polysaccharides. Ring structure and mutarotation. Homo and heteropolysaccharides.
Structural polysaccharides (cellulose, chitins, starch, dextrans, inulin, pectins, agar and
glycogen). Mucopolysaccharides, sialic acids, bacterial cell wall polysaccharides,
glycoproteins, membrane glycoproteins and their biological functions, Blood group
substances.

UNIT - II
Proteins: Structure and properties of amino acids and peptide bond, double bond
character. Basic concepts of theoretical conformational analysis of proteins, free rotation
about bonds and highly restricted rotations, torsional angles. Types of proteins and their
classification. Forces stabilizing protein structure and shape. Different levels of
structural organization of proteins. Purification of proteins and criteria of their purity.
Denaturation and renaturation of proteins.

UNIT - III
Structure and biological functions of fibrous proteins (keratin, collagen, elastin).
Globular proteins (Hemoglobin and myoglobin). Sickel cell Hb, lipoproteins,
metalloproteins, glycoproteins, nucleoproteins.
Chemical synthesis of polypeptides: Protection of N-terminal and C-terminal ends and
functional groups in the side chains, formation of peptide bond, strategy of chemical
synthesis and solid phase peptide synthesis of Merrifield. Methods of sequencing proteins

UNIT - IV
Lipids: Classification, structures, nomenclature and properties of fatty acids, essential
fatty acids, Glycerides. Hydrolysis of fats, saponification value, rancidity of fats, iodine
number. Reichert - Meissel number. Phospholipids structures & properties of different

UNIT - V

Nucleic Acids: Structure and properties of purines, pyrimidines, nucleosides and nucleotides.

Nucleic acid as genetic material: experimental evidences. Chargaff's rule, Structure of DNA, various forces responsible for stability of DNA, various forms of DNA, various classes of DNA, highly repetitive, moderately repetitive and unique sequence, DNA organization in chromatin, C-value paradox, denaturation and Renaturation, RNA structure and types.

Suggested Reading:

M.Sc. BIOCHEMISTRY (First Semester)

Paper - III: METABOLISM – I (Code - MBC 113)
MAX. MARKS: 70 TIMES: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attempt Question No. 1 & five more selecting one question from each Unit. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

UNIT - I

Principles of thermodynamics: open, closed and isolated thermodynamic systems, thermodynamic state functions, first and second laws of thermodynamics, concept of free energy, standard free energy, equilibrium constant, relationship between standard free energy change and equilibrium constant.

High energy compounds: Introduction and group transfer potential.
UNIT - II
Structural basis of free energy of hydrolysis of phosphoric acid anhydrides, phosphoric carboxylic anhydrides (acyl phosphates), enol phosphates and guanidinium phosphates, dependence of free energy of ATP hydrolysis on pH. ATP as the universal currency of free energy in biological system, ATP-ADP cycle. Coupling of reactions. Biological oxidation-reduction reactions: Oxidation reduction half reactions, the Nernst equation, calculation of ΔG from standard reduction potentials.

UNIT - III

UNIT – IV

UNIT - V

Suggested Reading:
M.Sc. BIOCHEMISTRY (First Semester)

Paper - IV: PLANT BIOCHEMISTRY (Code – MBC-114)
MAX. MARKS: 70 TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type
   covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions
   from each Unit I, II, III, IV & V. The candidates shall be required to attempt
   Question No. 1 & five more selecting one question from each Unit.
   As far as possible, the questions shall be short answer type and not essay
   type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of
   marks will be indicated part - wise.

UNIT - I
Plant cell: Structure of plant cell, Chemical and physical composition. Isolation of cell
organelles, plant cell wall.
Photosynthesis: Structure of photosynthetic machinery of plant and bacteria (chloroplast,
thylakoid, bacteriorhodopsin), Light and dark reaction, Photophosphorylation: Cyclic and
non -cyclic; Z-Scheme of photophosphorylation, Photolysis of water, Inhibitors of cyclic
and non-cyclic electron transport, Structure and reaction mechanism of electron transport
through the intermediates of photophosphorylation cycle viz., plastocyanin,
plastoquinones, cytochromes, PS-I and PS-II complex; Theory of electron transport
coupled with ATP synthesis in thylakoid membrane and their resemblance with
mitochondrial electron transport chain. Structure of LHC (Light harvesting complex) and
RC (reaction centre),
Energy transduction: Floreescence, phosphorescence,ground stage, singlet, doublet and
triplet stages.

UNIT - II
C3, C4 and CAM cycle; Compartmentation of C3, C4 and CAM pathways. Structure and
action of RUBISCO (Ribuloase 1,5-bisphosphate corboxylase oxygenase),

UNIT - III
photorespiration: Pathway and significance.
Sucrose and starch biosynthesis and regulation.
Biological N2 fixation: N2 fixing organisms structure and mechanism of action of
nitrogenase, role of leghaemoglobin. nif genes of Klebsiella pneumoniae and their role in
nitrogen fixation.

UNIT - IV
Nitrate Assimilation: Nitrate uptake structure and function of nitrate reductase and nitric
reductase and their role in regulation in assimilation of nitrate.
Sulphate assimilation. Free and bound pathways of assimilation of sulphate into cysteine.
Glutathione and its role in sulfur metabolism.
UNIT - V

Plant hormones/growth regulators: Physiological effects of different plant hormones. 
Mechanism of action of auxins, gibberellins, cytokinins, ABA and ethylene.
Secondary plant metabolism: Biosynthetic pathways (I) Classical acetate-mevalonate and
(ii) novel alternative non-mevalonate pathway of isoprenoid biosynthesis. Biosynthesis of
porphyrins, chlorophylls, carotenoids (lycopene & β-carotene), sterols (Brassinosteroids),
alkaloids (conine, codeine and morphine), phenolics and flavoriods.
Role of secondary metabolism in chemical defence.
Interaction between primary and secondary metabolic pathways.

Suggested Reading:
1. Handbook of photosynthesis (ed) Mohammad Pe sarakle, Marcel Dekkar, Inc. NY
Basel, Hong Kong 1997.
3. Seed: physiology of development and germination (2nd ed. 1994) J.D. Bewley and M.
Black Plenum Press NY.
4. Biochemistry of energy utilization i plants D.T. dennis Blackie, Glasgow and Lodnon
1987.
5. Plant Biochemistry by P.M. Dey and J.B. Harborne. Harcourt Asia PTE Ltd.,
Singapore.

M.Sc. BIOCHEMISTRY(First Semester)

Paper - V: Cell Biology & Physiology (Code MBC 115)
MAX. MARKS: 70
TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type
   covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions
   from each Unit I, II, III, IV & V. The candidates shall be required to attempt
   Question No. 1 & five more selecting one question from each Unit.
   As far as possible, the questions shall be short answer type and not essay
   type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of
marks will be indicated part-wise.

UNIT - I

UNIT – II
Cell cycle: interphase and M phases - mitosis and meiosis with special reference to spindle formation, movement of chromosomes, synaptosomal complex; regulation of cell cycle. The extra cellular matrix cell-cell interactions.

UNIT – III
Cancer: Carcinogenesis, characteristics of cancer cells, cancer causing agents, protooncogenes, oncogenes and tumor suppressor genes, Apoptosis.

UNIT – IV

UNIT – V

Suggested Reading:
M.Sc-BIOCHEMISTRY. (Second Semester)

Paper –VIII: ADVANCE MOLECULAR BIOLOGY – I (Code – MBC-121)
MAX. MARKS: 70 TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attempt Question No. 1 & five more selecting one question from each Unit. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

UNIT – I
DNA Replication: Possible modes of DNA replication, Meselson - Stahl experiment, DNA polymerases and other enzymes involved in DNA replication, Okazaki fragments, Mechanism of replication in prokaryotes and eukaryotes, inhibitors of DNA replication, different types of mutations and molecular basis of mutations,DNA repair mechanisms.

UNIT – II
Transcription: RNA polymerase/s in prokaryotes and eukaryotes, initiation, elongation and termination of transcription in prokayotes and eukaryotes, inhibitors of transcription. RNA replicases, reverse transcriptase, Post transcriptional modifications. Overlapping genes and split genes.

UNIT – III
Translation: Characteristics of the genetic code, biological significance of degeneracy, decoding the code, wobble hypothesis. Aminoacyl tRNA synthetases, anticodon loop, ribosomes structure and function in prokaryotes and eukaryotes. Polyribosomes, various factors and steps involved in protein synthesis in prokaryotes and eukaryotes Post translational processing, signal hypothesis and protein targeting.

UNIT – IV
Gene regulation in prokaryotes: A brief description of various levels of control of gene expression in prokaryotes, lac operon, trp operon, regulation of gene expression of lambda phage. Interaction between DNA and DNA binding proteins in prokaryotes.

UNIT – V
Suggested Reading:

M.Sc-BIOCHEMISTRY. (Second Semester)

Paper -IX: BIOCHEMICAL TECHNIQUES (Code - MBC 122)
MAX. MARKS: 70 TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attempt Question No. 1 & five more selecting one question from each Unit. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

UNIT – I
Measurement of pH: pH glass electrode, pH meter.
Titrimetry: Volumetric analysis, acid base titration, Redox titration, gravimetric and complexometric titration.

UNIT – II
Chromatography: Paper, TLC, GLC, HPLC, gel filtration, ion exchange & affinity chromatography.
UV & Visible Spectrophotometry: Basic Principles.

UNIT - III

UNIT - IV
Hydrodynamic methods: Sedimentation-Theory, preparatory & analytical ultra centrifuges, factors affecting sedimentation velocity, sedimentation coefficient measurement of S zoning centrifugation, DNA analysis, determination of molecular weight by sedimentation diffusion and sedimentation equilibrium methods.
UNIT - V
Membrane filtration, dialysis & their applications. Partial specific volume, Diffusion coefficient and their measurements. Viscosity: Theory, effect of macromolecules on the viscosity of the solution, measurement, molecular weight determination.

Suggested Reading:

M.Sc-BIOCHEMISTRY. (Second Semester)

Paper -X: METABOLISM –II (Code - MBC 123)
MAX. MARKS:70 TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attempt Question No. 1 & five more selecting one question from each Unit.
   As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

UNIT - I
Lipid catabolism: Degradation of triacylglycerols by lipases, Knoop's experiment fatty acid activation, transport of fatty acyl CoA into mitochondria, beta oxidation of saturated fatty acid, oxidation of unsaturated and odd carbon fatty acid, regulation of fatty acid oxidation, alpha and omega oxidation of fatty acid, peroxisomal, formation and utilization of ketone bodies.
Fatty acid biosynthesis: Acetyl CoA carboxylase, transport of acetyl CoA from mitochondrial matrix to cytosol, biosynthesis of saturated fatty acids, elongation and desaturation of fatty acids, biosynthesis of triacylglycerols, regulation of fatty acid metabolism, cholesterol biosynthesis and its regulation, biosynthesis of phosphoglycerides, sphingolipids, prostaglandins.
UNIT -II

UNIT -III

UNIT -IV
Nucleotide metabolism: Denovo biosynthesis of purine and primidine nucleotides. Regulation of purine and pyrimidine nucleotide biosynthesis, formation of deoxyribonucleotides. Biosynthesis of nicotinamide coenzyme, flavin coenzymes and coenzyme A. Salvage pathways of purines & pyrimidies. Catabolism of purines and pyrimidines.

UNIT -V

Suggested Reading:

M.Sc. BIOCHEMISTRY(Second Semester)

Paper - XI: ENZYMEOLOGY (Code - MBC 124)
MAX. MARKS: 70 TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attempt Question No. 1 & five more selecting one question from each Unit. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

UNIT - I

UNIT - II

UNIT - III
Enzyme inhibition: Types of reversible inhibitors (competitive Non Competitive and uncompetitive) derivation of equations for different types of inhibitors, determination of Ki and irreversible inhibitors (affinity labels and suicide inhibitors). Significance of inhibition.

UNIT - IV
Enzyme regulation: Control of enzyme activity, Coarse control: Enzyme induction and repression; fine control: feedback inhibition, Allosteric control with aspartate transcarbamoylase as an example, sigmoidal kinetics and their importance concerted and sequential models for action of allosteric enzymes. Reversible and irreversible covalent modifications of enzymes. Regulation by the binding of stimulatory and inhibitory proteins.

UNIT - V

**Suggested Reading:**
3. Enzyme structure and mechanism (1977) by Alan Fersht, Reading, USA.
4. Enzymatic reaction mechanism (1979) by Christopher Walsh, Freeman PUb., San Francisco.

Enzyme structure and function by S. Blackburn (1976) Marcel Dekker, Inc., NY.

**M. Sc. BIOCHEMISTRY (Second Semester)**

**Paper - XII: NUTRITIONAL BIOCHEMISTRY (Code-MBC-125)**

**MAX. MARKS:** 70  
**TIME:** 3 HRS

**Note:**
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attempt Question No. 1 & five more selecting one question from each Unit. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

**UNIT - I**


**UNIT - II**

Thermogenic effects of foods. Antinutrients: Naturally occuring food born toxicants, Protease inhibitors, Hemagglutinin, hepatotoxins, allergens, oxalates, toxin from mushrooms, animal food stuffs and sea foods.

Food additives: Antioxidants, antimicrobial agents, non-nutritive and low calorie sweetners, stabilizers and thickeners.
UNIT III
Protein energy malnutrition: etiology, clinical features, metabolic disorders and management of Marasmus and kwashiorkar diseases.
Starvation; Techniques for the study of starvation. Protein metabolism prolonged fasting. Protein sparing treatments during fasting. Basic concept of high protein, low caloric weight reduction diets.

UNIT- IV
Obesity: Definition and classification. Genetic and environmental factors leading to obesity. Obesity related diseases and management of obesity. Basic concept of high protein, low caloric weight reduction diets.
Nutritive values of common Indian food: Cereals and millets, sugar and starch foods, pulses and legumes, oil seeds and nuts, food of animal origin.

UNIT – V

Suggested Reading:
9. Principles of Food Science - I (Food Chemistry) Fennemone D R
10. Human Nutrition and Dietetics (8th Ed. 1982) by Davidson and Passmore ELBS.
M.Sc. BIOCHEMISTRY (Third Semester)

Paper - XV: ADVANCED MOLECULAR BIOLOGY-II (Code –MBC-211)
MAX. MARKS: 70                      TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type
   covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions
   from each Unit I, II, III, IV & V. The candidates shall be required to attempt
   Question No. 1 & five more selecting one question from each Unit.
   As far as possible, the questions shall be short answer type and not essay
   type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of
   marks will be indicated part - wise.

UNIT – I
Recombinant DNA Technology: Introduction, restriction endonucleases and their types
Cloning vectors for E. coli: Plasmids: properties of an ideal plasmid cloning vector, use
of pBR 322 and pUC plasmids as vectors, phages - use of phage lambda and M13 as
vectors, cosmids.

UNIT –II
Expression vectors, Cloning vectors for organisms other than E. coli: Cloning vectors for
yeast and animal cells. Formation of chimeric plasmids: Cutting DNA molecules using
restriction endonucleases, ligation of DNA, molecules by using synthetic linkers,
adaptors and homopolymer tailing, construction of genomic DNA library and cDNA
library, Selection and screening of recombinants: Various methods like genetic,
immunochemical, nucleic acid hybridization.

UNIT – III
DNA transfer: Vector mediated; Transformation, Transduction, Transfection & in vitro
packaging. Non vector mediated; Direct DNA uptake, electroporation, microinjection and
microprojectile.
Animal cell culture: Primary culture, primary cell lines, established cell lines and
applications of animal cell culture.
Transgenic animals: development and uses.

UNIT – IV
Genetics: Brief history of genetics, Basic principles of heredity, linkage, Recombination
and Eukaryotic gene mapping, Population genetics.
GENOMICS: an overview correlated genetic, cytological and physical maps of
chromosomes, map position based cloning of genes. The human genome project, RNA
and protein assays of genome function, evolution of genomes.

UNIT – V
Introduction to plant tissue and organ culture; Preparation of explants, formation of callus
and suspension cultures and plant regeneration from cells.
Plant genetic engineering; methods of delivering foreign genes Agrobacterium mediated and microprojectile bombardment mediated transformations; Transgenic plants: health and ecological risks associated with it; application of Bt genes in cereal crops.

**Suggested Reading:**


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**M. Sc. BIOCHEMISTRY (Third Semester)**

**Paper - XVI: CLINICAL BIOCHEMISTRY (Code-MBC-212)**

**MAX. MARKS: 70**

**TIME: 3 HRS**

**Note:**

1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attempt Question No. 1 & five more selecting one question from each Unit.
   As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

**UNIT- I**

Disorders of carbohydrates metabolism: Type I & Type II Diabetes mellitus, Glycohemoglobins Hypoglycemias, ketone acidosis, ketonuria, various types of glucose tolerance tests, Glycogen storage diseases and Galactosemia.

Disorders of lipid metabolism: Sphingolipidosis, atherosclerosis, Hypolipoproteinemia & Hyperlipoproteinemia.

**UNIT II**

Disorders of amino acids metabolism: Phenylalaninemia, homocystinuria, tyrosinemia and related disorders, aminoacidurias.
Disorders of nucleic acid metabolism: Disorders of purine and pyrimidine metabolism.

UNIT – III
Blood components and their functions plasma proteins blood coagulation mechanism and regulation, Biochemical aspects of hematology: Thalassemias and anaemias. Detoxification mechanism of the body: Phase I and phase II pathways.

UNIT – IV
Hormone disturbances: Disturbances related to thyroid functions, protein hormones, steroid hormones and adrenocortical hormones. Components of respiratory system and their functions, transfer of blood gases oxygen and carbon dioxide role of 2, 3 DPG, Bohr's effect and chloride shift, acid base balance and its regulation, acidosis and alkalosis.

UNIT V

Suggested Reading:

M.Sc. BIOCHEMISTRY (Third Semester)

Paper - XVII: IMMUNOLOGY (Code –MBC-213)
MAX. MARKS: 70 TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attempt Question No. 1 & five more selecting one question from each Unit. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

UNIT – I
Brief history of Immunology, Introduction to immune system-memory, specificity diversity, innate and acquired immunity, self vs non self discrimination, structure and functions of primary and secondary lymphoid organs. Phagocytic cells and their killing mechanisms, T & B lymphocytes.

UNIT – II
Antigen vs immunogen, Haptens, Structure and functions of immunoglobulins, isotypic, allotypic and idiotypic variations. Clonal selection theory-concept of antigen specific receptor, Differentiation of stem cells, recent advances in stem cell research

UNIT – III
Humoral and cell mediated immune responses, kinetics of primary and secondary immune responses, complement activation and its biological consequences, antigen processing and presentation, cytokines - role in immune responses. T and B cell interactions.

UNIT –IV

UNIT - V

Suggested Reading:
3. Immunology (1992) by Janis Kuby W H Freeman and Co. Ltd. USA.

M. Sc. BIOCHEMISTRY (Third Semester)

Paper - XVIII: Microbial Biochemistry (Code -MBC 214)
MAX. MARKS: 70
TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attempt
Question No. 1 & five more selecting one question from each Unit. As far as possible, the questions shall be short answer type and not essay type.

4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part-wise.

UNIT - I
Microscopy: Light and Electron microscopy

UNIT - II

UNIT - III
Bacterial growth and cultivation: Cultivation of aerobic and anaerobic bacteria, nutritional types, culture media. Bacterial growth curve and generation time, growth kinetics, measurement of growth, factors affecting growth, Control of microbial growth: physical and chemical methods, disinfectants and radiations.

UNIT - IV

UNIT - V
Fermentation Technology: Shake flask culture, batch, fed-batch and continuous cultures. Fermenter design - basic stirred tank bioreactor and other different types of fermenters. Instrumentation and control. Aeration and agitation, mass transfer and oxygen transfer. Down stream processing. Primary and secondary metabolites. Industrial production of antibiotics (β-lactam), ethanol, enzymes: lipases, protease, cellulose and amylases.

Suggested Reading:
M.Sc. BIOCHEMISTRY (Third Semester)

Paper –XIX: MOLECULAR AND IMMUNOLOGICAL TECHNIQUES
(Code – MBC-215)
MAX. MARKS: 70 TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type
   covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions
   from each Unit I, II, III, IV & V. The candidates shall be required to attempt
   Question No. 1 & five more selecting one question from each Unit.
   As far as possible, the questions shall be short answer type and not essay
   type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of
   marks will be indicated part - wise.

UNIT – I
Methods of studying nucleic acids: Chemical analysis of nucleic acids, molecular weight
determination.
Isolation and purification of RNA.
Purification of DNA from living cells (both plasmids and total cell DNA).

UNIT – II
Hybridization of nucleic acids and their labeling methods, determination of nucleic acids
sequences, restriction mapping of DNA. Blotting techniques; Southern, Northern,
Western and Dot blot. PCR, RFLP, RAPD, DNA fingerprinting.

UNIT – III
Site directed mutagenesis, chemical synthesis of oligonucleotides, cell free systems for
transcription and translation.
Antisense - RNA technology.
Introduction of DNA into living cells: Introduction into bacterial cells by transformation,
transfection and in vitro packaging.

UNIT – IV
Measurement of antigen antibody interaction : Affinity, avidity and cross-reactivity,
production of polyclonal and monoclonal antibodies, principles, techniques and
application, agglutination and precipitation techniques, radio immunoassay, ELISA &
ELISPOT, Immuno-fluorescence assays, Fluorescence activated cell sorter ( FACES )
techniques.

UNIT – V
Immunization : active immunization-Role of vaccines in the prevention of diseases.
Recent approaches to production of vaccines, immuno-prophylaxis, passive
immunization- Passive antibody therapy and serum therapy. Tissue typing, Microarrays
to assess gene expression, Preparation and properties of human immune serum globulins.

Suggested Reading:
1. Immunology (4th edn. 1998) by Ivan Roitt, J Brostoff and David Mole (4th edn)
   Mosby Times Mirror Int. Publ. Ltd.,
3. Immunology (1992) by Janis Kuby W H Freeman and Co. Ltd. USA.

M.Sc. BIOCHEMISTRY (FOURTH SEMESTER)

Paper – XXII: BIOSTATISTICS & BIOINFORMATICS (Code – MBC-221)
MAX. MARKS: 70 TIME: 3 HRS

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attempt Question No. 1 & five more selecting one question from each Unit. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

UNIT - I

Introduction and scope of biostatistics: Presentation of data, frequency distribution, graphical representation of data by histogram, frequency curve and cumulative frequency curve.
Central tendency and measures of dispersion, mean, median, mode and their properties partition value standard deviation and coefficient of variation.

UNIT - II

Simple correlation coefficient and regression coefficient, regression lines. Tests of significance: t-test, z-test, chi-square tests of heterogeneity and independence of attributes, F-test.
Analysis of variance (ANOVA): Principles of experimental designs, randomized block & latin square designs.

UNIT – III

Introduction to computers: general idea of classification and characteristics of computers, microprocessor input / output devices, internal representation of date (bits & bytes; binary, octal & hexadecimal system), Types of languages: machine, assemble & high level languages.
UNIT- IV

Programming Language (BASIC): BASIC as a high language characters, constants variable names and arithmetic expressions. Programming in C++.
Brief idea of software: M.S. Office (World, Excel, Power Point), DATA bases. Internet uniform resource locator (URL) World wide Web HTTP internet access: Netscape navigators Internet explorer. PDP, NRL - 3D

UNIT – V


Suggested Reading:
2.