Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

CIRCULAR NO.SU/Sci. & Tech./University Deptt./NEP/15/2023

It is hereby inform to all concerned that, the syllabi prepared by the Departmental Committee and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted **the following curriculum of All Post Graduate Degree Courses as per Norms of National Education Policy – 2020 under the Faculty of Science & Technology run at University Department, Dr.Babasaheb Ambedkar Marathwada University, Aurangabad** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Syllabi of Department of BAMU, Aurangabad.	Semester
1.	M.Sc.Chemistry specialization Inorganic Chemistry, Organic Chemistry, Physical Chemistry and self supported Analytical Chemistry	Ist and IInd Semester
2.	M.Sc.Statistics	Ist and IInd Semester
3.	M.Sc.Mathematics	Ist and IInd Semester
4.	M.Sc.Physics	Ist Semester
5.	M.Sc.Food Technology	Ist and IInd Semester
6.	M.Sc.Drug Intermediates Technology	Ist and IInd Semester
7	M.Sc. Information Technology	Ist to IVth Semester
8.	M.Sc.Computer Science	Ist to IVth Semester
9.	M.Sc.Botany	Ist and IInd Semester
10.	M.Sc.Enviornmental Science	Ist and IInd Semester
11.	M.Sc.Artificial Intelligence.	Ist to IVth Semester
12.	M.Sc.Biochemistry	Ist and IInd Semester

This is effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/NEP/2023/ 8743-51
Date:- 08.08.2023.

★★★★★

Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

1] **Head of the Department, All Departments, Dr.Babasaheb Ambedkar Marathwada University, Aurangabad.**
2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

1] The Director, Board of Examinations & Evaluation, Dr.BAMU,A'bad.
2] The Section Officer,[M.Sc.Unit] Examination Branch,Dr.BAMU,A'bad.
3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.
4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.
5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.BAMU,A'bad.
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7] The Record Keeper, Dr.BAMU,A'bad.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

FACULTY OF SCIENCE & TECHNOLOGY

2/1 Year P.G. Programme in Science

(M.Sc.)

As per National Education Policy-2020

(To be implemented from Academic Year-2023-24)

Course Structure and Curriculum

(Outcome Based Credit System)

Subject: Biochemistry

(Effective from 2023-24)

Professor & Head
Department of Biochemistry
Dr. Babasaheb Ambedkar
Marathwada University,
Aurangabad.

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PREFACE

Outcome Based Education (OBE) is the educational approach which focuses on student centric education in the context of development of personal, social, professional and knowledge (KSA) requirements in one's career and life. It is the decade ago curriculum development methodology. The educational triangle of *LEARNING-ASSESSMENT-TEACHING* is the unique nature of the OBE approach. The curriculum practices such as Competency Based Curriculum, Taylor's Model of Curriculum Development, Spadys' Curriculum principles, Blooms taxonomy and further use of assessment methodologies like, Norm-reference testing and Criterion reference testing, etc is being practiced since decades. It is also interesting to know that, globally, different countries and universities adopts the curriculum development models/approaches such as, CDIO (Conceive-Design-Implement-Operate), Evidenced Based Education, Systems' Approach, etc as the scientific and systematic approaches in curriculum design.

The authorities of Dr. BabasahebAmbedkarMarathwada University, Aurangabad (M.S.) in-lieu of accreditation standards of National Assessment and Accreditation Council, decided to opt for Outcomes Based Education (OBE). As the part of the decision, different meetings, workshops and presentations were held at the campus of university.

This document is the outcome of different meetings and workshops held at university level and department level. The detailed document is designed and the existing curriculum of the department is transformed in to the framework of OBE. This is the first step towards the implementation of OBE in the department. The document will serve all stakeholders in the effective implementation of the curriculum. The OBE is continuous process for quality enhancement and it will go a long way in order to enhance the competencies and employability of the graduates/Post-graduates of the university department.

Head of Department

OUTCOME BASED EDUCATION

Faculty of Science & Technology

Department of BIOCHEMISTRY

1. **Mission:**

   Mission Statement

   - To provide quality education to the students through state of art and education in biochemistry.
   - To provide a learning environment that helps the students to enhance problem solving skills, be successful in their profession and to prepare students to be lifelong learner by offering solid theoretical & practical foundation in various discipline of biochemistry and educating them about their professional and ethical responsibilities.
   - To provide exposure to students to the latest tools and technologies in the area of biochemistry.
   - To provide research based projects activities in the emerging area of biochemical technology.
   - To develop the man resource with sound knowledge theory & practical in the disciple of biochemistry and the ability to apply knowledge to the benefit of the society at large.

2. **Vision:**

   Vision Statement

- Producing quality students trained in the latest tools and technologies and striving to make university a world leader in the area of biochemistry.
- To achieve academic excellence in biochemistry of imparting in-depth knowledge to the students, facilitating research activities and cater to the ever changing industrial demand & societal needs.
- To be a centre of excellence in the discipline of biochemistry.
- The mission and vision of the organization help in preparation of strategic plan.

3. **Title of the Program (s):**
   a. **Master of Science in Biochemistry**

4. **Program Educational Objectives:**
   The program educational objectives (PEO) are the statement that describes the career and professional achievement after the program of studies (graduation/ post-graduation). The PEO s are driven form question no. (ii) of the Mission statement (What is the purpose of organization). The PEOs can be minimum three and maximum five.

PEO1: To have advance knowledge of biochemistry domain.

PEO2: To provide the professional services to industry, research organization, institutes.

PEO3: To provide the professional consultancy and research support for the relevant organization in the domain of super specialization.

PEO4: To opt for higher education, disciplinary & multi-disciplinary research and to be a life-long learner.

PEO5: To provide, value based and ethical leadership in the professional and social life.

5. **Program Outcomes:**

The program outcomes (PO) are the statement of competencies/ abilities. POs are the statement that describes the knowledge and the abilities the graduate/ post-graduate will have by the end of program studies.

a. In-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods of Biochemistry.
b. Apply/implement interface between, on the one hand, the history of Biochemistry and natural science and, on the other hand, issues pertaining to the areas of modern technology, health, and environment.
c. Skills in planning and conducting advanced chemical experiments and applying structural-chemical characterization techniques.
d. Skill in examining specific phenomena theoretically and/or experimentally,
e. Generation of new scientific insights or to the innovation of new applications of Biochemistry research.

6. **Course- Program outcome Matrix:**

The Program Outcomes are developed through the curriculum (curricular/co-curricular-extra-curricular activities). The program outcomes are attained through the course implementation. As an educator, one must know, ***"to which POs his/her course in contributing?"***. So that one can design the learning experiences, select teaching method and design the tool for assessment. Hence, establishing the Corse-PO matrix is essential step in the OBE. The course-program outcomes matrix indicates the co-relation between the courses and program outcomes. The CO-PO matrix is the map of list of courses contributing to the development of respective POs.

Dr.BabasahebAmbedkarMarathwada University, Aurangabad

Two Years Post Graduate Program

Course and Credits Distribution of two years/Master's Degree Program with Entry and Exit Option

Eligibility

M.Sc. Biochemistry Program

The student joining M. Sc. Biochemistry should have studied the following subjects at B.Sc. level

1. Biochemistry
2. Chemistry and Any one of the following subject
Botany / Zoology / Microbiology/ Biotechnology/ Environmental Science/ Molecular Biology/ Food Technology/Dairy Science/Home Science/Fishery with background in basic genetics

Students with non-biochemistry background at B.Sc. level should have studied Chemistry as one of the subject.

The optional courses to be offered will be decided by the department depending upon the faculty / expertise available.

Two-Year Post- Graduate Program

Course and credit Distribution of Two years/One YearPG/Master's Degree program with Entry and Exit Option

Year/Level	Sem	Major Subject		RM	OJT/FP	RP	Credits	Degree
		DSC Core Mandatory	DSE (Elective)					
First Year 6.0	I	3(4)+2=14	4	4	--	--	22	PG Diploma (after 3 Years of Degree)
	II	3(4)+2=14	4	--	4 Complete during summer break	--	22	
Cum.Cr.for PG Diploma		28	8	4	4	--	44	
Exit Option with Post-graduate Diploma (44 Credits) after first year or two semester with completion of course equivalent to 44 credits								
Year/Level	Sem	Major Subject		RM	OJT/FP/LC	RP	Credits	Degree
		DSC Core Mandatory	DSE (Elective)					
Second Year 6.5	III	3(4)+2=14	4	--		4 Minor	22	PG Degree after 3 Years UG or PG Degree after 4 Years UG
	IV	2(4)+2=10	4	--	--	6 Major	22	
Cum.Cr.for 1 Year PG Degree		22	8	4	4	10	44	
Cum.Cr.for 2 Year PG Degree		50	16	4	4	10	88	
2 years (4 Sem.) PG Degree 92 (Credits) after three year UG Degree or 1 Year (2 Sem.) PG Degree (44 Credits) after 4 year UG degree								
8.0		Course work min.12 credits 3(4)	Training in Teaching/education/pedogogy:4	16+Ph.D. Work				Ph.D. in subject

Note: DSC is Based on Specialization

Abbrevation:

Major: Comprising Mandatory- is based on Specialization

DSE: Discipline Specific Elective

OJT: On the Job Training

FP: Field Project (Corresponding to the Major (Core) Subject

RP: Research Project (Corresponding to the Major (Core) Subject

Internship/Apprenticeship: Corresponding to the Major (Core) Subject

AS PER NEP 2020

Illustrative Credit distribution structure for Two Years Programme with Multiple Entry and Exit options –

(Discipline Specific Core in Biochemistry

Class: M.Sc. First Year
Semester: I[st] Semester
Subject: Biochemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	BIC/MJ/500		3	-	3	-	3+3+3+3 +2 =14
	BIC/MJ/501		3	-	3	-	
	BIC/MJ/502		3	-	3	-	
	BIC/MJ/503	Practical Based on BIC/MJ/500, 501 and 502	-	6	-	3	
	BIC/MJ/504	Skill/Advance Technique		4		2	
DSE (Choose any one from pool of courses)	BIC/DSE/505		3	-	3	-	04
	BIC/DSE/506	Practical Based on BIC/DSE/1006 and 1007	-	2	-	1	
RM	BIC/RM/507	RM-I	4	-	4	-	04
			16	12	16	06	22 credits

Class: M.Sc. First Year: Biochemistry

First Semester: Major Mandatory - *DSC-Based on specialisation

1. DSC-1: BIC/MJ/500-Biomolecules

   DSC-2: BIC/MJ/501-Molecular Biology

   DSC-3: BIC/MJ/502-Bioenergetics and Metabolism

   DSC-4: BIC/MJ/503-Practical Based on BIC/MJ/1000, 1001 and 1002.

   DSC-5: BIC/MJ/504- Skill/Advance Technique.

2. DSE—: (Choose any one from Pool /Basket)
   1. : BIC/DSE/505-Cell Biology and Physiology
   2. BIC/DSE/506–Fermentation Technology

3. RM-1: ----- BIC/RM/507- Research Methodology

Class: M.Sc. First Year
Semester: II Semester
Subject: Biochemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	BIC/MJ/508		3	-	3	-	14
	BIC/MJ/509		3	-	3	-	
	BIC/MJ/510		3	-	3	-	
	BIC/MJ/511	Practical Based on BIC/MJ/508, 509and 510	-	6	-	3	
	BIC/MJ/512	Skill/Advance Technique	-	4	-	2	
DSE (Choose any one from pool of courses)	BIC/DSE/513		3	-	3	-	4
	BIC/DSE/514		2		1		
OJT/FP	BIC/OJT/FP/515	OJT/FP		6		4	04
			14	16	13	9	22 credits

Class: M.Sc. First Year: Biochemistry

Second Semester:

1. DSC-6: :BIC/MJ/508-Bioanalytical Chemistry.
   DSC-7: - BIC/MJ/509-Advanced Molecular Biology.
   DSC-8:- BIC/MJ/510-Enzymology.
   DSC-9:- BIC/MJ/511- Practical Based on BIC/MJ/508, 509 and 510------
   DSC-10: - BIC/MJ/512- Skill/Advance Technique.

2. DSE- 3&4 (T/P): (Choose any one from Pool /Basket)
   1: - BIC/DSE/513-Plant Biochemistry.
   2: - BIC/DSE/514-Biochemical and Environmental Toxicology.

3. BIC/OJT/FP/515: Field Project or On Job Training.

Class: M.Sc. Second Year
Semester: III Semester
Subject: Biochemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	BIC/MJ/516		3	-	3	-	15
	BIC/MJ/517		3		3	-	
	BIC/MJ/518		3	-	3	-	
	BIC/MJ/519	Practical based on BIC/MJ/516, 517 and 518		6		3	
DSE (Choose any one from pool of courses)	BIC/DSE/520		3		3		3
RP	BIC/RP/521	RP-1	-	8	-	4	04
			15	14	15	07	22 credits

Class: M.Sc. Second Year: Biochemistry

III Semester:

1. DSC-11: :BIC/MJ/516-Biostastics and Research Methodology.

   DSC-12: - BIC/MJ/517-Methods in Molecular Biology.

   DSC-13:- BIC/MJ/518-Nutritional Biochemistry.

   DSC-14: - BIC/MJ/519- Practical based on BIC/MJ/3001, 3002 and 3003.

2. DSE—5/6(T/P): (Choose any one from Pool /Basket)

   1: -BIC/DSE/520-Genetics for Biologists.

3. BIC/RP521: -- RP-1

Class: M.Sc. Second Year
Semester: IV Semester
Subject: Biochemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	BIC/MJ/522		3	-	3	-	10
	BIC/MJ/523		3	-	3		
	BIC/MJ/524	Field Project				4	
DSE (Choose any one from pool of courses)	BIC/MJ/525		3	-	3		06
	BIC/MJ/526		3		3		
RP	BIC/RP/527(Major)	RP-2	-	12	-	6	06
			12	12	12	10	22 credits

Class: M.Sc. Second Year: Biochemistry
Forth Semester:

1. DSC-16: : - BIC/MJ/522-**Immunochemistry.**

   DSC-17:: - BIC/MJ/523-Microbial Biochemistry.

   DSC-18:- BIC/MJ/524-Field Project

2. DSE—7&8 (T/P): (Choose any one from Pool /Basket)
   1: - BIC/MJ/525-Clinical Biochemistry.

   2: - BIC/MJ/526-Plant Biotechnology

3. BIC/RP/527-2: Major Research Project

M. Sc. Biochemistry Program Contents

SEMESTER I
Foundation Courses

Course Code: BIC/MJ/500
Course Name: Biomolecules **Total Marks 100, Total Credit : 03**

Unit I Marks: 25, Credit: 0.75

Carbohydrates and their derivatives
Monosaccharides and related compounds, glycosidic bond, disaccharides, polysaccharides, heteropolysaccharides.

Lipids
Fatty acids, Phospholipids, Cholesterol and related steroids, other biological lipids.Glycerolipids, sphingolipids, the eicosanoids.

Unit II Marks: 25, Credit: 0.75

Nucleotides and nucleic acids
Genetic significance of nucleic acids, structural properties of DNA, chemical synthesis of DNA, conformational behavior of RNA, nucleoproteins.

Analysis of nucleic acids
Isolation of nucleic acids, radioactive labeling of nucleic acids, restriction endonucleases, plasmids, purification of complementary DNA strands, hybridization by blotting, determining base sequence of DNA, preparation of DNA complementary to RNA.

Unit III Marks: 25, Credit: 0.75

Amino acids, peptides and polypeptides
Amino acids, peptides and polypeptides, determination of amino acid composition of proteins, determination of amino acid sequence of proteins, chemical synthesis of peptides and polypeptides.

Unit IV Marks: 25, Credit: 0.75

3-D structure of proteins
Information for folding, forces that determine folding, hierarchy of structural organization, functional diversification of proteins.

Characterization and purification of proteins
Methods of protein characterization, methods of protein purification.
Centrifugation, Dialysis, Lyophilization, Ultrafilteration, Chromatography, Electrophoresis,

Course Code: BIC/MJ/501
Course Name: Molecular Biology **Total Marks 100, Total Credit : 03**
Unit I Marks: 25, Credit: 0.75

DNA replication
Semiconservative replication of DNA, DNA synthesis in prokaryotes, replication of a viral chromosome, replication of the E. coli chromosome, DNA synthesis and chromosomal replication in eukaryotes, control of DNA replication, specific inhibitors of DNA replication, DNA degradation, DNA repair, DNA recombination.

Unit II Marks: 25, Credit: 0.75

RNA synthesis
Different classes of RNA, DNA dependent synthesis of RNA, eukaryotic transcription, other RNA synthesis, posttranscriptional modification and processing of RNA, Degradation of RNA by ribonucleases, inhibitors of RNA metabolism.

Unit III Marks: 25, Credit: 0.75

Protein synthesis
The cellular machinery of protein synthesis, steps in translation, deciphering the genetic code, code word assignments, inhibitors of protein synthesis, posttranslational modifications of proteins, intracellular protein degradation, lysosomes and protein degradation.

Unit IV Marks: 25, Credit: 0.75

Regulation of gene expression in prokaryotes
Regulation of gene expression in *E. coli*, regulation of gene expression in bacterial viruses.
Regulation of gene expression in eukaryotes
Gene regulation in unicellular eukaryotes, gene regulation in multicellular eukaryotes, regulatory phenomena associated with development.

Course Code: BIC/MJ/502
Course Name: Bioenergetics and Metabolism **Total Marks:100,** Total Credits: 03

Unit I Marks: 25, Credit: 0.75
Bioenergetics:
Energy transformation, Laws of thermodynamics, Biological oxidations, oxygenases, hydroxylases, dehydrogenases and energy transducing membranes. Gibbs energy, free energy changes and redox potentials, phosphate potential, ion electrochemical potentials, proton electrochemical potential, membrane potentials, photons energy interconversions. Chemo-taxis and chemoreceptors chemo-osmotic theory, ion transport across energy transducing membranes.Influx and efflux mechanisms.Proton circuit and electrochemical gradient, the transport and distribution of actions, anions and ionophores.Uniport, antiport and symport mechanisms, shuffle systems.
The mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron sulphur proteins, cytochromes and their characterization.The Q cycle and the stoichiometry

of proton extrusion and uptake; P/0 and H/P ratios.Reversed electron transfer, respiratory controls and oxidative phosphorylation, uncouplers and inhibitors of energy transfer.Fractionation and reconstitution of respiratory chain complexes.

ATP - synthetasecomplex.Microsomal electron transport, partial reduction of oxygen, superoxides.

Intermediary metabolism: Approaches for studying metabolism.

Unit II

Marks: 25, Credit: 0.75

Carbohydrates:
Glycolysis, citric acid cycle its function in energy generation and biosynthesis of energy rich bonds, pentose phosphate pathway and its regulation. Alternate pathways of carbohydrate metabolism.
Gluconeogensis, interconversions of sugars.
Biosynthesis of glycogen, starch and oligosaccharides.Regulation of blood glucose homeostasis.
Hormonal regulation of carbohydrate metabolism.

Unit III

Marks: 25, Credit: 0.75

Lipids
Fatty acid biosynthesis: Acetyl CoA carboxylase, Fatty acid synthase, desaturase and elongase. Fatty acid oxidation: (x, 0, w oxidation and lipoxidation. Lipid Biosynthesis: Biosynthesis of triacyglycerols, phosphoglycerides and sphingolipids, Biosynthetic pathways for terpenes, steroids and Prostaglandins. Ketone bodies: Formation and utilisation. Metabolism of Circulating lipids: chylomicrons, LDL, HDL and VLDL. Free fatty acids. Lipid levels in pathological conditions.

Unit IV

Marks: 25, Credit: 0.75

Amino Acids

Biosynthesis and degradation of amino acids and their regulation.Specific aspects of amino acid metabolism.Urea cycle and its regulation, In-born errors of amino acid metabolism.

Nucleic Acids
Biosynthesis or purines and pyrimidines, Degradation if purines and pyrimidines
Regulation of purine and pyrimidine biosynthesis, Structure and regulation of ribonucleotidereductase.
Biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides
Inhibitors of nucleic acid biosynthesis

Course Code: BIC/MJ/503
Course Name: Practical Based on BIC/MJ/500, 501, 502.

Total Marks: 100,Total Credits: 03

Chemical tests for bioconstituents.
Assay of enzymes like salivary amylases and alkaline phosphatases.
Biochemical estimation like cholesterol, sugars, free fatty acids, iodine value and sponification value in oils, Vitamin C in fruit juices,
Preparation of casein from milk and tests for proteins and amino acids.
Microscopic examination and chemical analyses of blood.
Electrophoretic separation of serum proteins.
Disc gel electrophoretic separation of isoenzymes.
Microscopic examination and chemical analyses of urine and stools.
Histobiology of blood, urine and stools.
Radio-immunoassay of hormones.
Bacterial and chemical analysis of domestic and industrial effluents.

Course Code: BIC/MJ/504
Course Name: Skill/Advance Technique. **Total Marks: 100,** Total Credits: 03

Course Code: BIC/DSE/505
Course Name: Cell Biology, Physiology **Total Marks:100,** Total Credits: 03

Cell Biology

Unit I

Marks: 25, Credit: 0.75

Cell classification: Cell variability (size, shape, complexity, functions).
Structural Organisation of prokaryotic and eukaryotic cells.Theultra structure of nucleus, mitochondria, endoplasmic reticulum, rough and smooth, Golgi apparatus, lysosomes and peroxisomes and their functions. Plant and animal cells: variation in structure and function.
The cytoskelton - microtubules and microfilaments.
Types of tissues, epithelium - types, epithelial apices - glycocalyx, microvilli.The basement membrane - structural features and characteristics.The extracellular matrix-collagen, elastin, fibrillin, fibronectin, laminin and protroglycans.

Unit II

Marks: 25, Credit: 0.75

Culture techniques to study cell division - cell division by mitosis and meiosis.Cell cycle.
Cell differentiation - organogenesis, morphological, functional and biochemical maturation of tissues.
Biochemistry of cancer - carcinogenesis, characteristics of cancer cell, agents promoting carcinogenesis.

Physiology

Unit III

Marks: 25, Credit: 0.75

Blood:Composition and functions of plasma, erythrocytes including Hb, leukocytes and thrombocytes plasma proteins in health and diseases.
Blood coagulation - mechanism and regulation. Fibrinolysis, transfers of blood gases oxygen and carbon dioxide. Role of2,3 DPG, Bohr effect and chloride shift.
Hydrogen ion homeostasis- Factors regulating blood pH - buffers, respiratory and renal regulation. Acid-base balance - metabolic and respiratory acidosis and alkalosis.

Unit IV

Marks: 25, Credit: 0.75

Digestive system: Composition, functions and regulation of saliva, Gastric, pancreatic, intestinal and bile secretions - digestion and absorption of carbohydrates, lipids, proteins, nucleic acids, minerals and vitamins.
Excretory system: Structure of nephron, formation of urine, glomerular filtration, tubular re-absorption of glucose, water and electrolytes - tubular secretion.
Regulation of water and electrolyte balance, role of kidneys and hormones in their maintenance.
The endocrine glands: secretion and function - reproduction, pregnancy and lactation. Biochemistry of vision.

Course Code: BIC/DSE/506
Course Name: Fermentation Technology **Total Marks: 100,** Total Credits: 03

Fermentation Technology

Primary and secondary metabolites in biotechnology, continuous and batch type culture techniques, principle types of fermentors, general design of fermentor, fermentation processesbrewing, manufacture of penicillin, production of single cell proteins, production strategies for other antibiotics and other organic compounds.

Course Code: BIC/RM/507
Course Name: Research Methodology **Total Marks: 100,** Total Credits: 4

SEMESTER II

Course Code: BIC/MJ/508
Course Name: Bio-analytical Chemistry **Total Marks:100,** Total Credits: 3

Unit I

Marks:25, Credit: 0.75

Isomerism: Structural isomerism, Stereoisomerism, geometrical isomerism (E & Z nomenclature)
Free radicals in **biological systems:** Oxygen as a free radical in the autooxidation of fats. Antioxidants (Free radical inhibitors in the cell such as vitamin A, vitamin E, vitamin C, Se etc.)
Stereochemistry: Optical isomerism, optical activity, meso-compounds, specific rotation, chirality, chiral center, enantiomers, diastereoisomers, D L, R S, threoerythro notations, conformation and configuration, dihedral angles, conformational analysis of ethane, n-butane, cyclohexane, monoand di-substituted cyclohexane, monosaccharides, boat and chair forms, eclipsed, gauche and staggered conformations, axial and equatorial bonds. Anomers and mutarotation, glycoside, epimers, glucopyranose, fructopyranose, periodic acid oxidation of sugars.

Unit II

Marks:25, Credit: 0.75

Water: Physical properties and structure of water, hydrogen bonding, ionization of water, pH scale, acids-bases, Handerson-Hasselbalch equation, buffers, ionization behaviour of amino acids and proteins, titration curve, buffer solutions and their action.
Radioisotope techniques: Nature of radioactivity, properties of (α, β and λ-rays, measurement of radioactivity, use of radioisotopes in research. *In vivo and in vitro* labelling techniques, double labelling, quenching, internal standard, channel ratio, external standard ratio, emulsion counting, radioactive decay, autoradiography.

Unit III

Marks:25, Credit: 0.75

Viscosity: Its measurement, viscosity of macromolecules, molecular weights of biomolecules. Sedimentation of macromolecules, centrifugation techniques and their applications, differential centrifugation, density gradient 'and ultracentrifugation techniques.Subcellular fractionation.
Electrophoretic techniques: Moving boundary and zonal electrophoresis, paper and gel electrophoresis, isoelectric focusing.

Unit IV

Marks:25, Credit: 0.75

Chromatography: Paper, TLC, Adsorption, partition, ion-exchange, reverse phase, gel filtration, affinity, gas chromatography, HPLC (High Pressure Liquid Chromatography).
Spectroscopy: Basic concepts and applications of X-ray diffraction, NMR, ESR, UV, IR, fluorescence, Raman, mass spectroscopy in structure determination of organic and biomolecules, CD and ORD.
Microscopy: Light, electron (scanning and transmission), phase contrast, fluorescence microscopy, freeze-fracture techniques, specific staining of organelles or marker enzymes.

Course Code: BIC/MJ/509
Course Name: Advanced Molecular Biology **Total Marks:100,** Total Credits: 3

Unit I Marks:40, Credit: 1

Recombinant DNA Technology

Methods of creating recombinant DNA molecule, splicing, properties of restriction endonucleases and their mode of action, selection/screening, construction of DNA library, genomic VscDNA library, chemical synthesis of gene, cloning vectors (X-phage, plasmid, M-13 phage, cosmid) shuttle vectors, yeast and viral vectors, expression vectors, uses of cloned gene, subcloning, sequencing by Sanger's method, proteins production in bacteria, site directed mutagenesis, RFLP, PCR, DNA finger printing, antisense-RNA technology, chromosomal walking.

Unit II Marks:25, Credit: 1

Hybridoma Technology

Monoclonal antibodies, mycelium cell fusion, selection of hybrids, hybridomas, protoplast fusion and HAT-medium, screening assays, purification and application of monoclonal antibodies.

Unit III Marks:, 35,Credit: 1

Plant and Animal Cell Culture

Micropropagation, somatic cell culture, somaclonal variations, somatic cell hybridization, protoplast isolation, protoplast fusion, protoplast culture, genetic transformation, various methods of gene transfer (all vector and vectorless methods), production of transgenic plants and animals, production of secondary metabolites, primary and transferred cell culture, differentiated cells in culture, applications.

Course Code: BIC/MJ/510
Course Name: Enzymology **Total Marks:100,** Total Credits: 3

Unit I Marks:25, Credit: 0.75

Review of unisubstrate enzyme kinetics and factors affecting the rates of enzyme catalyzed reactions. Michaelis pH functions and their significance.

Classification of multisubstrate reactions with examples of each class.Kinetics of multisubstratereactions.Derivation of the rate of expression for Ping Pong and ordered Bi Bi reaction mechanism.Use of initial velocity, inhibition and exchange studies to differentiate between multisubstratereaction mechanisms.

Concept of Convergent and Divergent evolution of enzymes.

Unit II

Marks:25, Credit: 0.75

Methods of examining enzyme-substrate complexes.
Flexibility and conformational mobility of enzymes.
Methods for measuring kinetic and rate constants of enzymic reactions and their magnitudes.
Enzymes Turnover and methods employed to measure Turnover of enzymes. Significance of enzymes Turnover.

Unit III

Marks:25, Credit: 0.75

□ Protein - Ligand binding, including measurement, analysis of binding isotherms.Co-operativityphenomenon.Hill and Scatchard Plots.
□ Allosteric enzymes, Sigmoidal kinetics and their physiological significance. Symmetric and sequential modes for action of allosteric enzymes and their significance.
□ Immobilized enzymes and their industrial applications.Effect of partition on kinetics and performance with particular emphasis on changes in pH and hydrophobicity.

Unit IV

Marks:25, Credit: 0.75

Multienzymesystem : Occurrence, isolation and their properties. Polygenic nature of multienzymesystems.Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetasecomplexes.ImmobilizedMultienzyme Systems and their applications.

Structure and function of coenzymes

Thiamine pyrophosphate, Pyridoxal phosphate, Nicotinamide, flavins, phosphopentetheine, alfa-lipoic acid, biotin, folate, vitamin B12, Iron containing coenzymes, coenzymes in methanogenesis.

Porphyrines

Porphyrin nucleus and classification, important metalloporphyrinsoccuring in nature, detection of porphyrins Spectrophotometry, bile pigments, chemical and physiological significance by and fluoroscence.

Mechanisms of enzyme catalysis

Enzyme catalyst and other chemical catalyst, unique features of enzyme catalysts, trypsin family of enzymes, chymotrypsin catalytic mechanism, carboxipeptidaseA, pancreatic RNAase A, lysozyme, lactate dehydrogenase.

Course Code BIC/DSE/513
Course Name: Plant Biochemistry

Total Marks:100, Total Credits: 3

Unit I

Marks:25, Credit: 0.75

Structure and functions of plant cell (including cell wall, plasmodesmata, meristematic cells, vacuoles, secretary systems and root quiescent zone), Isolation of cell organelles, absorption, adsorption and transport of water and ions in plants. Evapotranspiration.

Unit II Marks:25, Credit: 0.75

Photosynthesis - structure of organelles involved in photosynthesis in plants and bacteria. Proton gradients and electron transfer in chloroplasts of plants and in purple bacteria - differences from mitochondria. Light receptors - chlorophyll, light harvesting complexes, bacteriorhodopsin, rhodopsin as ion pump.
Photosystems I and II, their location, mechanism of quantum capture and energy transfer between photosystems - ferridoxin, plastocyanin, plastoquinone, carotenoids.

Unit III Marks:25, Credit: 0.75

The Hill reaction, photophosphorylation and reduction of CO2.
C_3 C^4 and CAM metabolism, light and dark reactions. Light activation of enzymes, regulation of photosynthesis. Photorespiration.

Biological nitrogen fixation and ammonia assimilation.
Nitrate and sulphate reduction and their incorporation into amino acids.

Translocation of inorganic and organic substances.

Unit IV Marks:25, Credit: 0.75

Special features of secondary plant metabolism, formation of phenolic acids, tannins, lignins, lignans, pigments, terpenes, terpenoids, plant phenolics, alkaloids and surface waxes - their biosynthesis and functions, cell wall components.

Plant hormones - Growth regulating substances and their mode of action.Molecular effects of auxin in regulation of cell extension and of gibberellic, abscisic acids and cytokinins in the regulation of seed dormancy, germination, growth and development, and embryogenesis.

Biochemistry of seed development and fruit ripening.

Defence system in plants.

Tissue culture and transgeneic plants.

Course Code: BIC/DSE/514
Course Name: Biochemical & Environmental Toxicology **Total Marks:100,** Total Credits: 3

Unit I Marks:25, Credit: 0.75

Definition and scope of toxicology: Eco-toxicology and its environmental significance. Toxic effects: Basis for general classification & nature. Dose - Response relationship: Synergism and Antagonism, Determination of ED 50 & LD 50' Acute and Chronic exposures. Factors influencing Toxicity.Pharmacodynamics&Chemodynamics.

Principles & procedures of testing for acute toxic effects: Regulatory guidelines, Mammalian systems affected & the clinical signs of Systemic Toxicity. Factors affecting acute Toxicity studies.

Unit II Marks:25, Credit: 0.75

Xenobiotic metabolism: Absorption & distribution. Phase I reactions. Oxidation, Reduction, Hydrolysis and Hydration. Phase 11 reactions/Conjugation: Methylation, Glutathione and amino acid conjugations. Detoxification.
Biochemical basis of toxicity: Mechanisms of Toxicity : Disturbance of Excitable membrane function. Altered calcium Homeostasis.Covalent binding to cellular macromolecules &Genotoxicity.Tissue specificity of Toxicity.
Toxicity testing: Test Protocol, Genetic toxicity testing & Mutagenesis assays: In vitro Test systems - Bacteria[Mutation Tests: Reversion Test, Ames Test, Fluctuation Tests and Eukaryotic Mutation Tests. In vivo Mammalian Mutation tests - Host mediated assay & Dominant Lethal Test. Use of Drosophila in Toxicity testing. DNA repair assays. Chromosome damage test.Toxicological evaluation of Recombinant DNA - derived proteins.

Unit III Marks:25, Credit: 0.75

Pesticide toxicity: Insecticides: Organochlorines, Anti-cholinesterases - Organophosphates and Carbamates. Fungicides.Herbicides.Environmental consequences of pesticide toxicity.Biopesticides.
Food toxicology: Role of diet in cardiovascular diseases and cancer. Toxi(iology of food additives.
Metal toxicity: Toxicology of Arsenic, mercury, lead and cadmium. Environmental factors affecting metal toxicity - effect of light, temperature &pH.

Unit IV Marks:25, Credit: 0.75

Diagnosis of toxic changes in liver and kidneys: Metabolism of Haloaklkanes, Haloalkenes&Paracetamol with their toxic effects on tissues.
Air pollution: Common air Pollutants & their sources. Air pollution &ozone.Air pollution due to chloroflurocarbons (CFCS) and asbestos.
Occupational toxicology & assessment of occupational hazards: Industrial effluent toxicology & Environmental health.
An overview of regulatory agencies: Responsibilities of regulatory agencies. Management of Toxicological risk. Regulatory approaches. Regulatory systems & organizations.

Course Code: BIC/MJ/511
Course Name: Practical Based on BIC/MJ/2001,2002, 2003
Total Marks:100, Total Credits: 4

Subcellular fractionation of organelles from liver cells and identification by the use of marker enzymes.
Purification of an enzyme using ion-exchange columns, gel filtration, affinity chromatography.
Molecular weight determination and kinetic studies on purified enzymes.
Writing a BASIC computer program to plot graphs of enzyme kinetic data by a variety of linear transforms and the Michaelis-Menten hyperbolic plot.
Protein synthesis in a cell free protein synthesizing system from rat liver or wheat germ.
Extraction of lipids from tissues, separation and estimation using thin layer chromatography.
Separation of phospholipid species in HPLC and estimation of their fatty acid composition by GLC.

Course Code: BIC/MJ/512-
Course Name: Skill/Advance Technique Total Credits: 2

Course Code: BIC/OJT/FP/515-
Course Name: On Job training/Field Project Total Credits: 4

SEMESTER III
Core and Research Component

Course Code: BIC/MJ/516
Course Name: Biostatistics & Research Methodology **Total Marks:100,** Total Credits: 3

Unit I Marks:25, Credit: 0.75

Population, Sample, variable, parameter, primary and secondary data, screening and representation of data. Frequency distribution, tabulation, bar diagram, histograms, pie diagram, cumulative frequency curves. Mean median, mode, quartiles and percentiles, measures of dispersion: range, variance, standard deviation, coefficient of variation, symmetry: measures of skewness and kurtosis
Sample space, events, equally likely events. Definition of probability (frequency approach), independent events.Addition and multiplication rules, conditional probability, Examples Bernoulli, Binomial, Poisson and Normal distributions.Mean and variance of these distributions (without proof).Sketching of p.m.f. and p.d.f, Use of these distributions to describe in biological models. Model sampling and Simulation study.

Unit II Marks:25, Credit: 0.75

Scatter plot, correlation coefficient (r), properties (without proof), Interpretation of r, linear regression. Fitting of lines of regression, regression coefficient, coefficient of determination. Use of random numbers to generate simple random samples with replacement and without replacement. Sampling distribution and standard deviation of sample mean. Stratified sampling and its advantages.
Hypothesis, critical region, and error probabilities. Tests for proportion, equality of proportions, equality of means of normal populations when variance known and when variances are unknown. Chi-square test for independence.P-value of the statistic. Confidence limits, Introduction to one way and two-way analysis of variance.

Unit III Marks:25, Credit: 0.75

Patent and Intellectual Property
Intellectual Property Areas : Patents, Trademarks and Copyrights
Parts of a Patient; The process of obtaining a patent; who can obtain a why obtain a patent?; Recent changes in IPR and patent policies.

Unit IV Marks:25, Credit: 0.75

Methodology of scientific research
The nature of scientific methods; Design of experiment,
Significance of statistical methods.

Course Code: BIC/MJ/517
Course Name: Methods In Molecular Biology **Total Marks:100,** Total Credits:3

Unit I Marks:25, Credit: 0.75

Physical properties of RNA: Classes of RNA, rRNA, tRNA, mRNA, HnRNA etc. Structure and methods of isolation and fractionation, gel electrophoresis and DNases, RNases, Phosphodiesterases.
Satellite DNA: C-value paradox, possible functions o satellite DNA, Mechanical strength, gene library, supppressor mutation, centromeric DNA, split genes.
Chromatin: Histone and non-histone proteins, general properties of histones, packing density. Nucleosomes, size variable linker, role of H 1.Selenoid structure.Transcriptionally active chromatin.
Unit II Marks:25, Credit: 0.75

Classes of DNA sequences: Zero-order bending, highly repetitive, unique. Methods of distinguishing double and single stranded DNA.
Re-association kinetics: Cot values, experimental procedure, qualitative significance, use of Ag* cesium sulphate.
Rapid DNA sequencing techniques and strategies details of a range of methodologies, e.g. plus and minus, dideoxynecleotide, partial ribosubstitution, Maxam and Gilbert.Use of thin gels, resolution etc. Interpretation of DNA sequences.

Role of counterions, deep and narrow grooves, single stranded DNA, A, B and Z DNA etc. Chirality of the helix, syn/antiparallel complementary stands.
Rapid RNA sequencing techniques: plus and minus, dideoxy-nucleotide, Zimmern and Kaesberg, Peattie, Simoncsits et al., method etc. Interpretation of RNA sequence.

Unit III Marks:25, Credit: 0.75

Movable genes: transposons and associated inverted repeats. The cassette model.Transforming DNA and plant genes.Retrovirus life cycle.
Strategies for cloning in plasmid vectors, features of commonly used vectors, their purification and characterization. Identification of bacterial colonies that contain recombinant plasmids. Bacteriophage λ vectors, growth, purification. Cloning in Bacteriophage λ vectors. Cloning in cosmidvectors.Construction of Genomic DNA libraries in cosmid vectors. Enzymes used in molecular cloning, restriction enzymes, DNA-Polymerases, ligases, kinases, phosphatases, and nucleases. DNA binding proteins.

Unit IV Marks:25, Credit: 0.75

Agarose gel and polyacrylamide gel electrophoresis, detection and extraction of DNA from gels.Construction and analysis of c-DNA; protocols and strategies for C-DNA cloning.Analysis of Genomic DNA by Southern Hybridization.Amplification of DNA by the polymerase chain reaction. Preparation of radiolabelled DNA and RNA probes. Synthetic oligonucleotides probes. Expression of cloned Genes in cultured cells.Screening expression with antibodies and oligonucleotides.Microarray chips and their applications.

Course Code: BIC/MJ/518
Course Name: Nutritional Biochemistry **Total Marks:100,** Total Credits 3

Unit I Marks:25, Credit: 0.75

Basic Concepts: Composition of human body. Energy content of foods. Measurement of energy expenditure: Direct & indirect calorimetry. Definition of BMR and SDA and factors affecting these.Thermogenic effects of foods. Energy requirements of man and woman and factors affecting energy requirements.
Carbohydrates: Dietary requirements and sources of available and unavailable carbohydrates. Physico-chemical properties and physiological actions of unavailable carbohydrates (dietary fibre).
Proteins: Protein reserves of human body. Nitrogen balance studies and factors influencing nitrogen balance. Essential amino acids for man and concept of protein quality Cereal proteins and their limiting amino acids.Protein requirement at different stages of development.
Lipids: Major classes of dietary lipids. Properties and composition of plasma lipo- proteins. Dietary needs of lipids. Essential fatty acids and their physiological functions.

Unit II Marks:25, Credit: 0.75

Electrolytes and water balance: Electrolyte concentrations of body fluids. Acid base regulation by the human body.Concept of metabolic and respiratory acidosis and alkalosis.
Minerals: Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.
Vitamins: Dietary sources, biochemical functions and specific deficiency diseases associated with fat and water-soluble vitamins. Hypervitaminosis symptoms of fat- soluble vitamins. Nutritional requirements during pregnancy, lactation and of infants and children.

Unit III Marks:25, Credit: 0.75

Processed Food: Food processing and loss of nutrients during processing and cooking
Anti-nutrients: Naturally occurring food born toxicants: Protease inhibitors, Hemagglutins, Hepatotoxins, Allergens, Oxalates, Toxins from Mushrooms, Animal food stuffs and sea foods.
Protein energy malnutrition (PEM): Aetiology, clinical features, metabolic disorders and management of Marsmus and Kwashiorkar diseases.
Starvation: Techniques for the study of starvation. Protein metabolism in prolonged fasting.Protein sparing treatments during fasting.Basic concept of High protein, low caloric weight reduction diets.

Unit IV Marks:25, Credit: 0.75

Obesity: Definition and classification. Genetic and environmental factors leading to obesity Obesity related diseases and management of obesity. Role of leptin in regulation of body mass.
Clinical nutrition: Role of diet & nutrition in the prevention and treatment of diseases: Dental caries, Fluorosis, Renal failure, Hyperlipidemia, Atherosclerosis & Rheumatic disorders, Inherited metabolic disorders: Phenyl ketonuria, Maple syrup disease. Hemocystinuria, Galactosemia, Gout, Diabetes Insipidus and Diabetes Mellitus.
Food allergy: Definition, Role of antigen, host and environment. Types of Hypersensitivities.Diagnosis and management of allergy.

Course Code: BIC/MJ/519
Course Name: Practical Based on BIC/MJ/3001,3002,3003 **Total Marks:100,**
Total Credits: 02

End groups analysis of proteins
Peptide mapping
Preparation of plasmid DNA, digestion by endonucleases and separation of DNA restriction fragment on agarose gel electrophoresis.
Restriction mapping of DNA
DNA and RNA techniques using nitrocellulose - Southern & Northern Blotting.
Electroblotting of DNA restriction fragments.
Sequencing of DNA and RNA on polyacrylamide gels.
Production of antisera - immunodiffusion and immuno-electrophoresis, complement fixation.

Course Code: BIC/DSE/520
Course Name: Genetics for Biologist **Total Marks:100,** Total Credits: 03

Unit I Marks:25, Credit: 0.75

Genetic Counseling

Possible approaches for tackling genetic disorders; Diagnosis of genetic defects; Positive eugenics; Negative eugenics; genetic counseling (antenatal diagnosis, fetus sexing).

Restriction Maps and Molecular Genetic Maps

Restriction Mapping. Restriction fragment length polymorphisms (RFLPs); Linkage and recombination between molecular and phenotypic markers; Random amplified polymorphic DNA (RAPDS) using PCR. Chromosome walking; reverse genetics and chromosome jumping

Unit II Marks:25, Credit: 0.75

Applied Genetics : Scope and Importance

What is applied genetics; Achievements of applied genetics; Need for future development.

Cloning and Amplification of DNA

Restriction enzymes in cloning; Techniques used in recombinant DNA technology (Polyacrylamide gel electrophoresis, Southern, Northern and Western blotting); Cloning vectors for recombinant DNA; cloning in bacteria, Molecular probes, Construction and screening of genomic and CDNA libraries; PCR and its applications.

Unit III Marks:25, Credit: 0.75

Isolation, Sequencing and Synthesis of Genes

Isolation of genes (genes with Tissue specific expression; mutant complementation, transpose tagging); Sequencing of genes (Maxam-Gitbert's method); Synthesis of genes (organochemical synthesis of TRNA gene and interferon gene).

Unit IV Marks:25, Credit: 0.75

Gene Transfer Methods and Transgenic Organisms

Gene transfers methods for animals and plants; Agro-bacterium mediated gene transfer, electroporation and particle gun. Transgenic animals (mouse and rabbit); Transgenic plants (Herbicide insect and virus resistance).

Course Code: BIC/RP/521 -1
Course Name: Research Project (Minor) **Total Marks:100,** Total Credits: 04

Research Project (Corresponding to the Major (Core) Subject

SEMESTER IV

Course Code: BIC/MJ/522
Course Name: Immunochemistry **Total Marks:100, Total Credits:03**

Unit I Marks:25, Credit: 0.75

Natural and acquired immunity, nature of immune response, cells and tissues of immune system. Components of natural immunity - complement system - classical and alternative pathway, opsonization and phagocytosis by macrophages.
Antigens, haptens and antibodies.Fine structure and subclasses of antibodies. Clonal selection theory and genetic basis of antibody diversity, immunoglobulin class switching. Antigen-antibody interactions.

Unit II Marks:25, Credit: 0.75

T and B lymphocyte classes.Major histocompatibility complex I and II. Processing and presentation of antigen by MHC, molecular basis of recognition, activation and maturation of T lymphocytes. Activation of B lymphocytes.Humoral immune response and its regulation. Cell mediated immunity - cytolytic and natural killer T lymphocytes.

Unit III Marks:25, Credit: 0.75

Cytokines, biogenic amines, interleukins and other effector components.
Cytokine signaling – JAK-STAT pathway
Programmed cell death – Apoptosis, Casapases and their role in cell death, Fas ligand signaling, TNF signaling
Immunodiffusion, immunoelectrophoresis, RIA, EIA, ELISA, fluroscent labelling and fluroscent cell sorter. Monospecific and bispecificantibodies.Hybridoma technology and monoclonal antibodies, catalytic antibodies.Western blotting.

Unit IV Marks:25, Credit: 0.75

Allergy and hypersensitivity, immunodeficiency - inherent and aquired, HIV, autoimmune disorders, mechanism of immunosuppression, graft rejection, organ transplantation and tumor immunology.
Interaction of microbes with immune system. Strategies adopted by viruses, bacteria and parasites to escape immune surveillance. PAMPS and Toll like receptors in microbe interaction

Course Code: BIC/MJ/523
Course Name: Microbial Biochemistry **Marks:100,**Total Credits:03

Microbiology

Unit I Marks:25, Credit: 0.75

Types of microorganisms: Mycoplasma, Protozoa, archea and yeast, fungi, general characteristics of main groups of microorganisms. Criteria used in the classification of microorganisms - cytology, genetics, host specialization, serology, different phases of growth.

Nutrition, physiology and growth of microbial cells. Microbial growth: The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yield, synchronous growth, continuous culture

Unit II Marks:25, Credit: 0.75

Gram positive and gram-negative organisms.Structure and functions of peptidoglycan in gram-positive and gram-negative organisms.Functions of polymeric components in outer membrane and acidic polymers in gram-negative organisms.

Special features of bacterial metabolism.Food spoilage, fermentation, food-borne infection.
Role of microorganisms in domestic and industrial sewage. Microbiological standards

Virology

Unit III Marks:25, Credit: 0.75

Virus structure, virus proteins, virus classification schemes
methods of assay: culture methods, serological detection, complement fixation, plaque reduction assay, neutralization tests

Replication of RNA viruses - negative strand (VSV), positive strand (polio), retroviruses (to include all events in the infectious cycle).

Unit IV Marks:25, Credit: 0.75

Replication of DNA viruses (Adenovirus or SV40). Herpes simplex virus, cytomegalovirus
Virus-host interaction
Vaccines and prevention – smallpox, polio, AIDS, rotavirus vaccine, influenza

Course Code: BIC/DSE/524
Course Name: Field Project **Total Marks:100,** Total Credits: 04
Field Project (Corresponding to the Major (Core) Subject

Course Code: BIC/MJ/525
Course Name: Clinical Biochemistry **Total Marks:100,** Total Credits: **3**

Unit I Marks:25, Credit: 0.75

Introduction to laboratory principles and instrumentation in Clinical Biochemistry.
Automation in the Clinical Biochemistry
Instrumental concepts
Chemical reaction phase
Measurement approaches
Selection of instruments.
Quality Assurance
Control of Pre-analytical variables
Control of analytical variables
External and internal quality control measurements.

Unit II Marks:25, Credit: 0.75

Disorders of Carbohydrate Metabolism
Diabetes mellitus
Glycohemoglobins.
Hypoglycemia's.
Ketone bodies
Various types of glucose tolerance tests. Glycogen storage diseases
Galactosemia
Lipids, Lipoproteins and Apolipoproteins
Physiology of lipids/lipoproteins, lipidosis
Clinical inter-relationships of lipids (sphingolipidosis, multipisclerosis), Lipoproteins and apolipoproteins.
Diagnostic tests for apolipoproteins, HDL-cholesterol, LDL-cholesterol and triglycerides disorders.

Unit III Marks:25, Credit: 0.75

Disorders of Amino Acid Metabolism
Phenylalaninemia, homocystineuria, tyrosinemia and related disorders, aminoacidurias.
Evaluation of Organ Function Tests
Assessment and clinical manifestations of renal, hepatic, pancreatic, gastric and intestinal functions, bilirubin metabolism.
Clinical presentation and diagnosis of various organ diseases.
Diagnostic Enzymes: Aspartate aminotransferase, Alanine aminotransferase, Creatine kinase Aidolase, Lactate dehydrogenase
Enzyme tests in determination of myocardial infarction, pancreatitis, biliary diseases

Unit IV Marks:25, Credit: 0.75

Hormonal Disturbances
Protein hormones, anterior pituitary hormones, posterior pituitary hormones, steroid hormones, adrenocortical steroids, reproductive endocrinology, thyroid function.
Disorders of Mineral Metabolism
Hypercalcemia, hypocalcemia, normocalcemia, hypophosphatemia, hyperphosphatemia.
Detoxification Mechanism in the Body
Enzymes of detoxification - polymorphism in drug metabolizing enzymes.
Detection of toxic substances by specific procedures.

Course Code:BIC/DSE/526
Course Name: Plant Biotechnology **Total Marks:100, Total Credit 03**

Unit I Marks:25, Credit : 0.75

Plant pathogens and integrated defense response to infection
Gene silencing as an adaptive defense
Natural products and plant disease resistance

Unit II Marks:25, Credit : 0.75

Programmed cell death
Hypersensitive response of plants and mitochondrial function
Biochemistry of airborne signals during plant defense
Co-evolution and plant resistance to natural enemies

Unit III Marks:25, Credit : 0.75

Production of transgenic organisms: microbes
Producing proteins in bacteria and fungi
Methods to produce transgenic plants
Herbicides, manipulating herbicide tolerance in plants
benefits and problems of herbicide tolerance in plants

Unit IV Marks:25, Credit : 0.75

Plants with increased resistance to insects
Biotechnology and tomato, genetic modifications of foods, oils and starches
Improving plant tolerance to environmental stress
Production of transgenic animals
Release of transgenic organisms in the environment
Safety and regulation of genetically engineered food

Course Code: BIC/RP/527-2
Course Name: Research Project (Major) Total Credits: 06

Major Research Project (Corresponding to the Major (Core) Subject

Reference Books and literature for M. Sc. BIOCHEMISTRY Program

Bioanalytical Chemistry

Stereo chemistry of organic compounds (1994) by E L Eliel& SHW Awley., Inter Science Pub.30, Wiley and Sons.Inc.
Organic Chemistry (6th Ed. 2000) by R T Morrison & R N Boyd, Prentice Hall of India, New Delhi.
Organic Chemistry Vol.1 Fundamental Principles (6th Ed. 1985) by IL Finar, ELBS.
Vol.2 Stereo Chemistry and the Chemistry of Natural Products.(5th Ed. 1985) by I L Finar, ELBS.
Lehninger's Principles of Biochemistry (2nd Ed 2000) D L Nelson and M M Cox, Macmillan Worth Pub.Inc NY.
Physical Biochemistry by Kansal Edward Van Holde (1971) Prentice Hall Inc. New Jersey.
Physical Biochemistry 2nd Ed (1 982) by David Friefelder, W H Freeman and Co. NY.
Principles and Techniques of Practical Biochemistry (4th Ed 1999) by K Wilson and J Walker (eds.) Cambridge Univ. Press.

CELL BIOLOGY AND PHYSIOLOGY

Molecular Biology of the Cells (3rd Ed 1994) by Alberts et al., Garland Publications Inc NY and London.
Cell Biology (1993) by E S Sedava, Jones and Barlett Publishers Boston, London.
Cell and Molecular Biology (8th Ed. 2001) by E D P de Robertis& E M F de Robertis (Jr) Lippincott Williams & Wilkins, Philadelphia.
Principles of Cell Biology (1988) by Klein Smith and M. Kish, Harper-CellinsPub.Inc. New Delhi.
Text book of Medical Physiology (10th Ed. 2001) by A C Guyton & J E Hall, Harcourt Asia.

BIOENERGETICS AND METABOLISM

Lehninger's Principles of Biochemistry (2ndedn. 2000) by D L Nelson and M M Cox, Macmillan, Worth Pub Inc., NY.
Biochemistry (4th Ed. 1992) by LubertStryer W H Freeman & Co., NY
Harper's Biochemistry (25th Ed.) by R K Murray and others. Appleton and Lange, Stanford.

PLANT BIOCHEMISTRY

Handbook of photosynthesis (Ed.) Mohammad Pesarakle, Marcel Dekkar, Inc. NY. Basel. Hong Kong 1997.

Introduction to plant biochemistry (1983) T W Goodwin and E I Mercer.Pergaman Press, Oxford, NY, Toronto, Sydney, Paris, Frankfurt.
Seed: physiology of development and germination (2nd Ed. 1994) J D Bewley and M Black Plenum Press NY.
Biochemistry of energy utilization in plants D T dennis Blackie, Glasgow and London 1987.
Plant Biochemistry by P M Dey and J B Harborne. Harcourt Asia PTE Ltd., Singapore.

ENZYMOLOGY

The chemical kinetics of enzyme action by K J Laidler and P S Bunting, Oxford University Press, London.
Enzymes by M Dixon, E C Webb, CJR Thorne and K F Tipton, Longmans, London.
Enzyme structure and mechanism (1977) by Alan Fersht, Reading, USA.
Enzymatic reaction mechanism (1979) by Christopher Walsh, Freeman Pub., San Francisco.
Immobilized enzymes (1978) by lchiroChibata, Halsted Press Book.
Enzyme structure and function by S Blackburn (1976) Marcel Dekker, Inc., NY.

ADVANCED MOLECULAR BIOLOGY

Biochemistry (2nd Ed 1995) by Donald Voet and Judith Voet.
Molecular Biology of the gene (IV Ed 1987) J Watson NH Hopkin J W Roberts J P StertzAMWeiner, Freeman Pub., San Francisco.
Genes Vil Benjamin Lewin (2000) Oxford Univ Press. London.

Immunochemistry

Immunology (4th Ed. 1998) by Ivan Roitt, J Brostoff and David Mole (4th edn) Mosby Times Mirror Int. Pub.Ltd.
Essential lmmunlogy (9th Ed. 1997) by Ivan Roift Blackwell Science Ltd.
Immunology (1992) by Janis Kuby W H Freeman and Co. Ltd. USA.
Immunology (2nd Ed. 991) by Edwards S Golub, Sinauer Associate, Sunderland.

METHODS IN MOLECULAR BIOLOGY

Molecular cloning: a laboratory manual (Vol.1, 2 & 3) (1989) by T.Maniatis, E.F.Fritsch, J.Sambrook. Cold Spring Harbor Laboratory Publications
RNA Isolation and Analysis by P Jones, J. Qiu, D.Rickwood(1stEd. 1994) Bios Scientific Publishers.
Gene and Probes: A Practical Approach Series (1995) by B D Hames and S J Higgins. Oxford University Press.
Gel Electrophoresis of Nuclei Acids: A Practical Approach (1990) by D.Rickwood and B.D.Hames. Oxford University Press.

NUTRITION BIOCHEMISTRY

Nutrition- An integrated approach (3rd Ed. 1984) R L Pike and M L Brown, Wiley & Sons Inc., NY.
Text Book of Biochemistry and Human Biology G P Talwar, Prentice Hall.

Mechanism and Theory in Food Chemistry (1996) DWS Wong, CBS, New Delhi.
Text Book of Human Nutrition (1996) M S Bamji N PralhadRao and V Reddy, Oxford & IBH Publishers.
Nutritional Biochemistry and Metabolism Linten.
Principles of Food Science -1 (Food Chemistry) Fennemona D R.
Human Nutrition and Dietetics (8th Ed. 1982) by Davidson and Passmore ELBS.
Modern Nutrition in Health and Diseases (7th Ed. 1988) by Maurice E Skills and V R Young K M Varghese Co. Bombay.

BIOSTATISTICS

Biostatistics: A foundation for analysis in the health. (7th Ed. 1999) by W W Daniel John Wiley and Sons Inc., New York.

BIOCHEMICAL AND ENVIRONMENTAL TOXICOLOGY

General and Applied Toxicology 1995 by Marrs and Turner, Macmillan Press Ltd.
Basic Environmental Toxicology (1994) by LorrisG.Corkerhem and Barbara S S Shane CRP Press Inc.
Introduction to Food Technology by TakayurkiShibamato& Leonard F. Bzeldanes.
Molecular Biotechnology 2nd Ed 1994 by Barnard R Glick & J J Pasternak.

BIOMEMBRANES AND CYTOSKELETON

Molecular Cell Biology by H. Lodish, David Baltimore, et al W. H. Freeman Publication, 1996
Biological Membranes Findlay and Evans
Biochemistry of Tissues by Banks
Cell by Cooper

MUSCLE BIOCHEMISTRY

Biochemistry by LubertStryer, Freeman & Co., NY.
Principles of Biochemistry -Smith, Lehman, Lefkowtz, Handler and Smith.
Lehninger's Principles of Biochemistry - D L Nelson and M M Cox, Macmi.lian/Worth Pub Inc., NY.
Biochemistry of Lipids, Lipoproteins and Membranes (1991) - D E Vance and J E Vance, Elsevier Sci.

MICROBIAL BIOCHEMISTRY

Microbial World (5th Ed. 1987) R Y Stanier, Hampshire-Macmillan Press.
Medical Microbiology (12th Ed. 1973) Cruckishank R and others, ELBS Press, London.
Microbiology (1967) B D Davis, R Delbecco, H M Eisent H S Ginsberg, Hoeber Med Divn NY.
Microbiology (5th Ed. 2000) Michael J Peiczar (Jr) ESC Chan, N R Kreig, Tata McGraw Hill.

CLINICAL BIOCHEMISTRY

Tietz Fundamentals of Clinical Chemistry - (5th Ed.)C A Burtis, E R Ashwood (eds.) Saunders WB Co.
Notes on Clinical Chemistry - Whitby L G, A F Smith, G J Beckett, S M Walker, Blackwell Sci Inc.
Principles of Internal Medicine (1983) Harrison T R, McGraw Hill, NY.

MEDICAL AND ENVIRONMENTAL BIOCHEMISTRY

Clinical Chemistry by Kaplan L.A. and Pesce A. J. C. V. Mosby, 1989
Clinical Biochemistry by W. J. Marshall and S. K. Bangert, Churchill Livinston N.Y. 1995
Practical Clinical Biochemistry (Varley) by Gowenlock
Biochemical Aspects of Human Diseases by Elkeles and Tavill
Biodiversity by Hawksworth

NEURO BIOCHEMISTRY

Basic Neurochemistry by Siegel.
Elements of Molecular Neurotoxicology by CUM Smith.
Neuroanatomy by Grossman &Neavy.

GENETICS FOR BIOLOGISTS

General Genetics Sub Owen and Edger.
Genes VII (2000) Benjamin Lewin, Oxford Univ Press.
Molecular Biology of Gene (4th Ed. 1987) Watson *et al* Freeman Pub. San Francisco.

PLANT BIOTECHNOLOGY

Plant Biochemistry - James Bonner and J.R. Varner
Introduction to Plant Biochemistry - Goodwin
Plant Physiology - Salisbery
Plant Biochemistry & Molecular Biology - P.J. Lea & R.G. Heagood
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