Office :2419622
Chairman :2419624

UNIVERSITY OF MYSORE

DEPARTMENT OF STUDIES IN BIOCHEMISTRY

MANASAGANGOTHRI
MYSORE -570 006

No.MG.Bio/ 386|2025-26

Date. 23|03|2026

Proceeding of the Board of Studies in Biochemistry
Date and Time: 14/03/2026 AT 11.00 AM onwards

Members:

1. Prof. K.Kemparaju — Chairman
   DOS in Biochemistry
2. Prof. Ramachandra Kini — Member
   DOS in Biotechnology
3. Prof. M. Y Sreenivas — member
   DOS in Microbiology
4. Prof. K. S. Girish — member
   Tumkur University
5. Dr. Naveen, S — member
   DIBT, Mysuru.

Chairperson welcomed all the Members to the meeting of BOS in Biochemistry and placed the agenda for the discussion

1. Discussion on changes in the Program of M.Sc. Biochemistry syllabi and scheme of Examination according to LOBE pattern.
   Decision: A major revision of the syllabus (80%) for M.Sc. Biochemistry was proposed by the Chairman and the same was discussed by the members. After detailed deliberations the revised syllabus was approved for implementation from academic year 2026-27 onwards.
2. Preparation of Panel of Examiners for M.Sc. Biochemistry examination 2026-27.
   Decision: The BOS revised and approved the panel of examiners for year 2026-27
3. Subject referred to the BOS by the University for its Consideration and opinion.
   The members discussed the changes in the PhD Course work syllabus for PhD in Biochemistry to include a 2 credit course on 'Research and Publication Ethics' and to increase the total credits for PhD course work to 12 as mandated by the UGC (Univ. Ltr No. AC2(S)/07/2024-25 dated02-03-2026).
   Decision: The members approved to change the credit pattern of the PhD Course work in Biochemistry to 12 credits and inclusion of the 2 credit course on 'Research and Publication Ethics'.
4. Any other subject with permission of the Chair- NIL

The meeting was concluded with vote of thanks.

1. Prof. K.Kemparaju — Chairman
2. Prof. Ramachandra Kini — Member
3. Prof. M. Y Sreenivas — member
4. Prof. K. S. Girish — member
5. Dr. Naveen, S — member

Members of the BoS

Sl. No.	Name and Designation		Signature
1.	Dr. K. Kemparaju Professor, Chairperson, DoS in Biochemistry University of Mysore, Mysuru	Chairman	
2.	Dr. AiyeshaFirdouse Assistant Professor Department of Biochemistry Yuvaraja's College, University of Mysore, Mysuru	Member	
3.	Dr. GirishChandran HoD, Department of Biochemistry SBRRMahajana First Grade College (A), Jayalakshmipuram, Mysuru	Member.	
4.	Dr. JyotsnaKaranth Assistant Professor Department of Biochemistry Maharani's Science College for Women, Mysuru	Member	
5.	Smt. Blessy George Assistant Professor Department of Biochemistry St. Philomena's College, Bangalore-Mysore Road, Mysuru	Member	

Chairman
Board of Studies in Biochemistry
University of Mysore
Manasagangotri, Mysore-570 006
INDIA

UNIVERSITY OF MYSORE
DEPARTMENT OF STUDIES IN BIOCHEMISTRY
MANASAGANGOTRI, MYSURU

17th March 2026

PROCEEDINGS OF THE BOARD OF STUDIES MEETING
-BIOCHEMISTRY UG

The meeting of the Board of Studies for B.Sc. Biochemistry program was held on 17th March 2026at 10 am at DoS in Biochemistry, University of Mysore, Mysuru-570005. Chairperson welcomed the members and conducted the meeting. The meeting proceedings are as follows:

Agenda:

1. Syllabus for 5th and 6th Semesters of B.Sc. Biochemistry for 2024 batch (which is in 4th semester now).
2. Syllabus for all semesters 1 to 6 for 2025 onwards batches (Currently in 2nd semester and new batches from 2026-27)

RESOLUTIONS:

The board unanimously approved:

1. Syllabus for 5th and 6th Semesters of B.Sc. Biochemistry for 2024-27 batch (which is in 4th semester now).
   5th Semester: DSC 5T, DSC 6T, DSC 5P
   6th Semester: DSC 7T, DSC 8T, DSC 6P

2. Syllabus for all semesters 1 to 6 are subjected to minor revision, for 2025-26 onwards batches (Currently in 2nd semester and new batches from 2026-27).
   1st Semester: DSC 1T, DSC 1P
   2nd Semester: DSC 2T, DSC 2P
   3rd Semester: DSC 3T, DSC 3P, DSE 1, DSE 2
   4th Semester: DSC 4T, DSC 4P, SEC 1, SEC 2
   5th Semester: DSC 5T, DSC 6T, DSC 5P
   6th Semester: DSC 7T, DSC 8T, DSC 6P

SYLLABUS FOR B.SC. BIOCHEMISTRY- 5& 6 SEMESTERS
FOR 2026-27 BATCH
THE BATCHES WHICH ARE ENTERING 5TH SEMESTER
DURING JULY-AUGUST 2026

SEM	COURSE TITLE	TYPE	CODE	CREDITS
5	METABOLISM II AND CLINICAL BIOCHEMISTRY	THEORY	DSC-5T	3
	MOLECULAR BIOLOGY AND GENETIC ENGINEERING	THEORY	DSC-6T	3
	METABOLISM AND CLINICAL BIOCHEMISTRY	PRACTICAL	DSC-5P	2
6	HUMAN PHYSIOLOGY	THEORY	DSC-7T	3
	IMMUNOLOGY	THEORY	DSC-8T	2
	PHYSIOLOGY AND IMMUNOLOGY	PRACTICAL	DSC-6P	2

SYLLABUS FOR B.SC. BIOCHEMISTRY- 1-6 SEMESTERS
FOR 2026-27 BATCH
THE BATCHES WHICH ARE ENTERING 1ST OR 3RD SEMESTER
DURING JULY-AUGUST 2026

SEM	COURSE TITLE	TYPE	CODE	CREDITS
1	FOUNDATIONS OF BIOCHEMISTRY	THEORY	DSC-1T	3
	FOUNDATIONS OF BIOCHEMISTRY	PRACTICAL	DSC-1P	2
2	BIOMOLECULES	THEORY	DSC-2T	3
	BIOMOLECULES	PRACTICAL	DSC-2P	2
3	BIOANALYTICAL TECHNIQUES	THEORY	DSC-3T	3
	BIOANALYTICAL TECHNIQUES	PRACTICAL	DSC-3P	2
	CELLULAR BIOCHEMISTRY	THEORY	DSE-1	2
	MICROBIAL BIOCHEMISTRY	THEORY	DSE-2	2
4	ENZYMOLOGY AND METABOLISM I	THEORY	DSC-4T	3
	ENZYMOLOGY	PRACTICAL	DSC-4P	2
	NUTRITION	PRACTICAL	SEC-1	2
	PLANT BIOCHEMISTRY	PRACTICAL	SEC-2	2
5	METABOLISM II AND CLINICAL BIOCHEMISTRY	THEORY	DSC-5T	3
	MOLECULAR BIOLOGY AND GENETIC ENGINEERING	THEORY	DSC-6T	3
	METABOLISM AND CLINICAL BIOCHEMISTRY	PRACTICAL	DSC-5P	2
6	HUMAN PHYSIOLOGY	THEORY	DSC-7T	3
	IMMUNOLOGY AND TOXICOLOGY	THEORY	DSC-8T	3
	PHYSIOLOGY AND IMMUNOLOGY	PRACTICAL	DSC-6P	2

Syllabus for B.Sc. Biochemistry- 1-6 Semesters

FOR 2026-27 BATCH

THE BATCHES WHICH ARE ENTERING 1ST OR 3RD SEMESTER

DURING JULY-AUGUST 2026

SEM	COURSE TITLE	TYPE	CODE	CREDITS
1	**FOUNDATIONS OF BIOCHEMISTRY**	THEORY	DSC-1T	3
	FOUNDATIONS OF BIOCHEMISTRY	PRACTICAL	DSC-1P	2
2	**BIOMOLECULES**	THEORY	DSC-2T	3
	BIOMOLECULES	PRACTICAL	DSC-2P	2
3	**BIOANALYTICAL TECHNIQUES**	THEORY	DSC-3T	3
	BIOANALYTICAL TECHNIQUES	PRACTICAL	DSC-3P	2
	CELLULAR BIOCHEMISTRY	THEORY	DSE-1	2
	MICROBIAL BIOCHEMISTRY	THEORY	DSE-2	2
4	**ENZYMOLOGY AND METABOLISM I**	THEORY	DSC-4T	3
	ENZYMOLOGY	PRACTICAL	DSC-4P	2
	NUTRITION	THEORY/ PRACTICAL	SEC-1	2
	PLANT BIOCHEMISTRY	THEORY/ PRACTICAL	SEC-2	2
5	**METABOLISM II AND CLINICAL BIOCHEMISTRY**	THEORY	DSC-5T	3
	MOLECULAR BIOLOGY AND GENETIC ENGINEERING	THEORY	DSC-6T	3
	METABOLISM AND CLINICAL BIOCHEMISTRY	PRACTICAL	DSC-5P	2
6	**HUMAN PHYSIOLOGY**	THEORY	DSC-7T	3
	IMMUNOLOGY AND TOXICOLOGY	THEORY	DSC-8T	3
	PHYSIOLOGY AND IMMUNOLOGY	PRACTICAL	DSC-6P	2

2026-27 BATCH

B.Sc. I SEMESTER (SEP)
FOUNDATIONS OF BIOCHEMISTRY
COURSE CODE: DSC-1T SEPBC-101

COURSE TITLE	**FOUNDATIONS OF BIOCHEMISTRY**
COURSE CODE	**DSC-1T SEPBC-101**
COURSE CREDITS	03
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	48 (3 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Unit: I **12 hours**

Introduction: Definition, scope and important discoveries of Biochemistry.

Acids, Bases and Buffer: Bronsted Lowry concept, Lewis concept of acid and base, ionic product of water, pH scale, Buffers, Henderson- Hasselbalch equation, preparation of acidic and basic buffersolutions, Theory of acid base indicators with an example, pH titration curve of polybasic acid v/s base.

Electrochemistry and Distribution law: Electrodes (Hydrogen Electrode & Calomel electrode), applications of electrodes, Distribution law - Distribution law, partition coefficient, Applications of distribution law.

Photochemistry: Definition of photochemistry, fluorescence, phosphorescence, chemiluminescence, and bioluminescence with an example.

Colligative properties: Definition, types ofOsmotic pressure, laws of osmotic pressure (only statement), Hypotonic, hypertonic and isotonic solutions. Effect of osmotic pressure on living cells.

Unit II **12 hours**

Colloids: Meaning of true solution, colloidal solution and coarse suspension. Differences between lyophilic and lyophobic sols.Fundamental study of Donnan membrane equilibrium-application in biological system.Elementary studies-Tyndal effect, Brownian movement, applications of colloidal chemistry Emulsion and emulsifying agents.

Co-ordination compounds: Transition metals, properties (color, oxidation states, magnetic properties)Co-ordinate bond, double and complex salts – differences with examples. Co-ordination number.Porphyrin nucleus and classification.Important metalloporphyrin occurring in nature, structure and their biological importance (Hb, cytochrome, chlorophyll, Vitamin B12).Bilepigments–Types, structure and biological importance.

Nitrogen: Fixation of atmospheric nitrogen, symbiotic and non-symbiotic nitrogen cycle, environmental pollution by nitrogenous compounds.

Phosphorus: Phosphorus cycle, importance of phosphorus in biological system.

Oxygen: Importance of oxygen in biological system, formation and role of ozone layer

in maintenance of life on earth, effect of environmental pollutants on ozone layer.

Sulphur and Selenium: Importance of compounds of sulphur and selenium in biological system. Effect of sulphur compounds on environmental pollution.

Unit 3: 12 hours

Hydroxy acids: Structure, properties and biological importance of Lactic acid (action of heat, oxidation), tartaric acid (salt formation), and citric acid (action of heat and salt formation).

Dicarboxylic acids and keto acids: Structure and biological importance of fumaric acid, succinic acid,Pyruvic acid, α-ketoglutaric acid, oxaloacetic acid.

Heterocyclic compounds: Occurrence**,** structural formula and biological importance of furan, pyrrole, thiophene, pyridine, pyran, thiazole, pyrimidine, purine, indole, imidazole.

Steroids: Basic ring structure in steroids. Structure and biological importance of cholesterol, biological importance of ecdysone, ergosterol and estradiol.

Terpenes: Isoprene rule, classification, occurrence and importance of limonene, Juvenile hormone-I.

Flavonoids/ Phenolics: Occurrence and biological importance of Quercetin, Capsaicin anthocyanin and curcumin.

Alkaloids: Definition, classification based on their chemical composition with example, physiological action of LSD and Morphine, Biological importance of reserpine, piperine, cocaine, theobromine, caffeine, nicotine& atropine.

REFERENCES:

1. Puri, Sharma, ArunBhal& B S Bhal, Pathania Text Book of Physical Chemistry
2. Puri, Sharma, ArunBhal& B S Bhal, Pathania Text Book of Inorganic Chemistry
3. A Guide to Organic Reaction Mechanism - P. Sykes
4. General &Inorganic Chemistry - R.P.Sarkar
5. Inorganic Chemistry - R.L.Dutta
6. New Concise Inorganic Chemistry - J.D.Lee
7. F.A.Cotton&G.Wilkinson. Basic Inorganic Chemistry, John Wiley (1998)
8. Douglas, Mcdaniel and Alexander: Concepts and Models In Inorganic Chemistry, John Wiley, 3rd Edition (1994).
9. James E.Huheey, Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Public, 4th Edition (2013).
10. Pattabhi.V. and Gautham.N. (2002) Biophysics. Narosa Publishing House, India.
11. Stereochemistry of Carbon Compounds- D.Nasipuri

B.Sc. I SEMESTER (SEP)
FOUNDATIONS OF BIOCHEMISTRY
COURSE CODE: DSC-1P SEPBC-102

COURSE TITLE	**FOUNDATIONS OF BIOCHEMISTRY**
COURSE CODE	**DSC-1P SEPBC-102**
COURSE CREDITS	02
TYPE OF THE COURSE	PRACTICAL
TOTAL CONTACT HOURS	64 HOURS (4 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

1. Concept of molarity, molality and normality. Calculation and preparation of solutions: Percentage solution, Molar solution, Normal solution, Dilution of stock solutions.
2. Calibration of volumetric glassware (Burette, pipette and volumetric flask).
3. Preparation of standard oxalic acid. Standardization of NaOH and estimation of H_2SO_4 in the given solution (phenolphthalein).
4. Preparation of standard sodium carbonate solution, standardization of HCl (Methyl orange) and estimation of NaOH in the given solution. (Methyl orange or phenolphthalein).
5. Preparation of standard potassium bipthalate. Standardization of NaOH and estimation of HCl in the given solution. (Phenolphthalein).
6. Preparation of ZnSO4. Standardization of EDTA and estimation of total hardness of water using eriochrome black-T indicator.
7. Preparation of standard $K_2Cr_2O_7$. Estimation of ferric/ferrous mixture using diphenylamine indicator.
8. Preparation of standard oxalic acid. Standardization of NaOH and estimation of acidity in vinegar.
9. Preparation of standard potassium bipthalate. Standardization of NaOH and estimation of alkalinity of given antacid.
10. Preparation of standard $K_2Cr_2O_7$. Standardization of sodium thiosulphate and estimation of $CuSO_4$.

REFERENCES:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Dr. O. P. Pandey, D. N. Bajpai, dr. S. Giri, Practical Chemistry S. Chand and Co. Ltd.,
4. Principles of Practical Chemistry- M. Viswanathan
5. Instrumental Methods of chemical Analysis B.K Sharma.
6. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata McGraw Hill
7. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
8. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S. Chand and Co.
9. Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).
10. General Chemistry experiment – Anil J Elias (University press).

B.Sc. II SEMESTER (SEP)
BIOMOLECULES
COURSE CODE: DSC-2T SEPBC-201

COURSE TITLE	**BIOMOLECULES**
COURSE CODE	**DSC-2T SEPBC-201**
COURSE CREDITS	03
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	48 (3 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Unit I: Carbohydrates 16 hrs

Carbohydrates: Definition, classification, biological importance.

Monosaccharides: Configuration relationship of D-aldoses, D-ketoses. General Properties of aldoses and ketoses, oxidation, reduction, reducing property, formation of glycosides, acylation, methylation, condensation-phenyl hydrazine, addition-HCN, Inter-conversion of aldoses and ketoses by chemical method.Stereochemistry of Monosaccharides, (+) and (-), D and L, epimers, anomers,and diastereomers.Mutarotation.Structure of galactose, fructose, mannose and ribose.Elucidation of open chain structure and ring structure of glucose.Structure and biological importance ofaminosugars (Neuraminic acid and Muramic acid).Deoxy sugars, sugar acids,

Disaccharides: Occurrence and structures of maltose, isomaltose, sucrose, lactose, and trehalose. Establishment of linkages in maltose.Biological importance of trehalose.

Polysaccharides: Classification based on composition and biological role. Partial structure, occurrence and importance of starch, glycogen, inulin, cellulose, chitin, and pectin.

Glycosaminoglycans: Occurrence, importance and the structure of the repeating units of heparin, hyaluronic acid, teichoic acid and chondroitin sulphate. Bacterial cell wall polysaccharide, peptidoglycans.

Unit II: Aminoacids, peptides and proteins 16hrs

Amino acids: Structure and classification of amino acids based on polarity. Reactions of amino groups acids with HNO_2,Ninhydrin, $LiAlH_4$, Phenyl isothiocyanate, Dansyl chloride,Fluorodinirobenzene, Hydrazine. D & L notation Zwitterionic properties.Concept of Pka and pI.Reaction of carboxyl group.D & L notation.

Peptides: Formation and characteristic ofpeptide bond. Structure and biological importance of glutathione.Biological significance of valinomycin, leu-enkephalin and endorphins.Chemical synthesis of dipeptides by Merrifield solid phase synthesis.

Proteins: Isolation-salting in and salting out, pH precipitation and solvent precipitation. Methods of purification-dialysis.

Classification of proteins based on solubility, structure and functions with examples. Primary Structure of proteins, methods of determining N- and C- terminal aminoacids, amino acid composition. Sequencing by Edman's degradation method.**Secondary Structure** – α Helix.β-sheet, β-bend. **Tertiary structure**: Forces stabilizing the tertiarystructure. Structureof myoglobin.**Quaternary structure:** 3D structure of haemoglobin. Denaturation and renaturation of proteins.Anfinsen's experiment.

Unit III: Lipids and Nucleic acids 16Hrs

Lipids: Classification and biological role. Fatty acids – Nomenclature of saturated and unsaturated fatty acids.Physiological properties of fatty acids.**Acylglycerols:** Mono, di and triacylglycerol. Saponification, saponification value, iodine value, acid value and theirsignificance.Rancidity,Hydrolysis.**Phosphoglycerides:** Structure of lecithin (Phosphotidyl choline), cephalins, phosphotidyl inositol, phosphotidyl serine. Biological role of phopshoglycerides.**Sphingolipids:** Structure and importance of sphingomyelin. **Glycosphingolipids:** Composition, structure and importance of gangliosides and cerebrosides. **Eicosanoids:** Structure of PGE2, and PGF2α importance of prostaglandins. Biological roles of thromboxane, leukotrienes and prostaglandins. **Plasma lipoproteins:** Types-Chylomicrons, VLDL, LDL and HDL. Apolipoproteins and their functions.

Nucleic acids: Composition of DNA and RNA .Structure of Nucleosides and nucleotides.Other functions of nucleotides-sources of energy, components of coenzyme and second messengers. Chargaff's rule. Watson and Crick model of DNA. **RNA:** Composition, types (mRNA, tRNAandrRNA), secondary structures of tRNA – clover leaf model. **Nucleic acid Chemistry**-UV absorption, effects of acids and alkali on DNA and RNA. Chemical reactions of DNA and RNA.Melting of DNA (Tm).

Suggested Readings:

1. Principles of Biochemistry (1982), A.L., Lehninger, Worth Publishers, Inc. New York.
2. Outlines of Biochemistry E.E. Conn and P.K. Stumpf. (1976) WileyEastern, New Delhi.
3. Biochemistryby L. Stryer (1995) W.H. Freeman Press, San Francisco, USA.
4. Biochemistry, by Voet, D. and Voet, J.G. (2004). 3rd Edition, John Wiley & Sons, Inc.USA.
5. Biochemistry by U. Sathyanarayana Books and Allied (P) Ltd. Kolkata, ISBN 0-87893- 214-3,(2014).
6. Text book of Biochemistry by J.L Jain (2016)
7. Medical Biochemistry by Ramakrishnan (2012)
8. Text Book of Biochemistry by D.M. Vasudevan (2018)
9. Text Book of Biochemistry by A.C. Deb, 9th revised edition (2017)

B.Sc. II SEMESTER (SEP)
BIOMOLECULES
COURSE CODE: DSC-2P SEPBC-202

COURSE TITLE	**BIOMOLECULES**
COURSE CODE	**DSC-2P SEPBC-202**
COURSE CREDITS	02
TYPE OF THE COURSE	PRACTICAL
TOTAL CONTACT HOURS	64 HOURS (4 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

1. Qualitative analysis of monosaccharides (Glucose and Fructose).
2. Qualitative analysis of di and polysaccharides.
    - Lactose, Maltose and Sucrose
    - Starch
3. Reactions of lipids: Triacylglycerol and cholesterol (Solubility, Acrolein, Salkowski and Lieberman-Burchard tests).
4. Precipitation reactions of proteins (Albumin).
5. Colour reactions of proteins (Albumin, Casein and Gelatin)
6. Qualitative analysis of amino acids (Arginine, Tyrosine, Tryptophan, Phenylalanine and Cysteine)
7. Reactions of nucleic acids: Diphenylamine test and orcinol test.

References:

1. Practical Biochemistry, GeethaDamodaran, Jaypee, 2011
2. Biochemical methods, S. Sadasivam, A. Manickam, 3rd Edition, New Age International Pvt Ltd, 2007
3. An Introduction to Practical Biochemistry, David Plummer, 3rd edition 2017
4. Laboratory manual in Biochemistry, J. Jayaraman 2011

B.Sc. III SEMESTER (SEP)
BIOANALYTICAL TECHNIQUES
COURSE CODE: DSC-3T SEPBC-301

COURSE TITLE	**BIOANALYTICAL TECHNIQUES**
COURSE CODE	**DSC-3T SEPBC-301**
COURSE CREDITS	03
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	48 (3 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Unit-1 **12hours**

Chromatography: General principles of chromatography – adsorption and partition. Principle, procedure and applications of: Paper chromatography – Ascending, descending and circular, 2D–chromatography, TLC. Column chromatography - gel filtration, ion – exchange chromatography, affinity chromatography, HPLC, FPLC, GLC.

Unit-2 **12hours**

Centrifugation: Definition,sedimentation, sedimentation coefficient, angular velocity, centrifugal field, relative centrifugal field, Svedberg unit. Types – Preparative, differential, density gradient (Rate zonal and Isopycnic) – principle, procedure and applications. Types of rotors and their design.Ultracentrifugation- construction and applications.

Radio isotopic methods: Radioactivity, definition and types (Natural and artificial), characteristics of radioactive elements, units of radioactivity, Types of radioactive decay, Properties of α, β, γ radiations. Group displacement law, Decay law - decay constant, half-life period and average life of a radioactive element. Detection of radioactivity – GM counter and scintillation counters (only principle and working). Applications of radioisotopes – 3H, 14C, 131I, 60Co and 32P. Biological effects of radiations. Safety measures in handling radioisotopes

Unit-3 **12hours**

Electrophoresis: Supporting media - paper, agarose and polyacrylamide. Chemistry of polymerization of acrylamide gels, procedure and applications of native PAGE, SDS- PAGE and agarose. Visualization techniques- comassive brilliant blue, silver stain, ethidium bromide, Principle and application of capillary electrophoresis and isoelectric focusing.

Spectroscopy: Dual nature of light, electromagnetic spectrum, electronic transition in spectroscopy. Beer-lambert law and its limitations, principle, design and application of UV-Visible spectrophotometer and colorimeter, determination of molar absorption coefficient of molecules. Principle and application of fluorimeter, IR, Mass and NMR spectroscopy.

References

1. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer2011
2. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8thEdn. Andreas Hoffman and Samuel Clockie, Ed., Cambridge University Press, 2018.
3. Biochemistry and Molecular Biology; 5th Edn. D. Papachristodoulou, A. Snape, W.H. Elliott, and D. C. Elliott, Oxford University Press 2014
4. Biophysical chemistry principle and techniques by Upadhyay and Upadhyay, Himalaya Publishing House
5. Bioinstrumentation by L Veerakumari, MJP Publishers, Chennai.
6. Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay and Nath – Himalaya Publ. House

B.Sc. III SEMESTER (SEP)
BIOANALYTICAL TECHNIQUES
COURSE CODE: DSC-3P SEPBC-302

COURSE TITLE	**BIOANALYTICAL TECHNIQUES**
COURSE CODE	**DSC-3P SEPBC-302**
COURSE CREDITS	02
TYPE OF THE COURSE	PRACTICAL
TOTAL CONTACT HOURS	64 HOURS (4 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

1. Separation of amino acids by circular paper chromatography
2. Separation of amino acids by TLC
3. Separation of carbohydrates by TLC
4. Separation of amino acids by Ascending paper chromatography
5. Separation of amino acids by Descending paper chromatography
6. Separation of plant pigments by column/paper chromatography
7. Verification of Beer's law.
8. Demonstration of absorption spectra for the color pigments.
9. Determination of Molar extinction coefficient of any colored compound.
10. Estimation of glucose by DNS method

B.Sc. III SEMESTER (SEP)ELECTIVE COURSE
CELLULAR BIOCHEMISTRY
COURSE CODE: DSE-1 SEPBC-303

COURSE TITLE	**CELLULAR BIOCHEMISTRY**
COURSE CODE	**DSE-1 SEPBC-303**
COURSE CREDITS	02
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	32 (2 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	02
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

Unit 1: 16Hrs

Introduction to cells:

Cells: Types-Prokaryotic and eukaryotic cells, plant and animal cells. Structure, functions and differences.

Subcellular Structures: Structure and Functions: Nucleus, chromosomes, mitochondria, chloroplast, ribosomes, endoplasmic reticulam, golgi complex, lysosomes, glyoxysomes and peroxisomes. Cytoskeletons- Distribution, types, structure and biological importance.

Plasma membrane : Chemical composition, Structure (Fluid Mosaic model) and function. Membrane fluidity and factors affecting membrane fluidity.

Unit 2: 16hrs

Membrane transport: Diffusion: Simple diffusion, Facilitated diffusion- Definition, example (Glucose transporter). Symport, uniport and antiport.

Active transport: Primary active transport (Na^+- K^+ ATPase pump) and Secondary active transport (Na^+- glucose transporter).

Ion channel (voltage gated and ligand gated- acetyl choline receptors).

Cell death: Definition, mechanism and differences between apoptosis and necrosis.

Cell signaling:GPCRs, structure and mechanism. Tyrosine Kinase receptors.

B.Sc. III SEMESTER (SEP) ELECTIVE COURSE
MICROBIAL BIOCHEMISTRY
COURSE CODE: DSE-2 SEPBC-304

COURSE TITLE	**MICROBIAL BIOCHEMISTRY**
COURSE CODE	**DSE-2 SEPBC-304**
COURSE CREDITS	02
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	32 (2 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	02
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

Unit 1: Study of Micro-organisms 16 Hrs

Spontaneous generation (abiogenesis), Biogenesis, Germ theory of Disease, Koch's Postulates.Microorganisms in biological world.Whittaker's Five- kingdom and three-kingdom concept of living organisms (General characteristics of those groups).

Classification of Stains: Simple and differential staining, Staining micro-organisms – principle and procedure of gram stain and acid fast stain. Principles and methods of sterilization: Hot Air Oven. Autoclave, Pressure Cooker. Different types of microscopes, construction and working principles of Simple microscope (dissection microscope)

Microbial growth and nutrition: Major nutritional types of microorganisms. Nutritional requirements of microorganisms. Growth curve – phases of growth and their significance.Factors affecting growth : Temperature, Light, pH, Oxygen and Saline requirements. Measurement of growth by cell number (Haemocytometer) and cell mass (Turbidometer, photometer).

Unit 2: Industrial Microbiology 16hours

Media – types, cultivation of aerobic and anaerobic bacteria. Pure cultures and cultural characteristics; Serial dilution, Pure cultures by isolation -i) pour plate ii) spread plate iii) streak plate. Batch and continuous culture.Microbial spoilage of food and food preservation techniques. Microbial spoilage of food – Fruits, vegetables, meat, poultry, canned foods.

Important methods of food preservations. Physical method- High temperature, Canning, Low temperature, Drying. Chemical method- Chemical preservatives-Salient features of the chemical preservatives.

Fermentors – types and components. Production and importance – Alchoholic beverages (Beer and Wine), Fermented products of milk,antibiotic production (penicillin).

Antibiotics: Definition, Mechanism of action of penicillin, streptomycin, and chloramphenicol, antibiotic resistance in brief.

REFERENCES :

1. Prescott L.M. Harley J.P. and Klein D.A. Microbiology (5th edition) McGraw Hill, New York. 2008
2. PelczarJr, M.J. Chan, E.C.S. and Kreig, N.R. .Microbiology, Mc. Graw Hill.Inc, NewYork.2006
3. Salle, A.J. Fundamental principles of Bacteriology.(7thedition).Tata McGraw-Hill publishing company Ltd, New Delhi. 1996
4. Stainer, Ingharam, Wheelis and Painter. General Microbiology. 5th Edition. Macmillan Education, London.1987
5. A Text book of Microbiology. Dubey , RC and Maheswari D K . S. Chand & Company Ltd., New Delhi. 2005

B.Sc. IV SEMESTER (SEP)
ENZYMOLOGY AND METABOLISM I
COURSE CODE: DSC-4T SEPBC-401

COURSE TITLE	**ENZYMOLOGY AND METABOLISM I**
COURSE CODE	**DSC-4T SEPBC-401**
COURSE CREDITS	03
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	48 (3 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Unit-1 :Introduction to Enzymes: 16 Hrs
General characteristics, definition with examples of holoenzyme, apoenzyme, cofactors, coenzymes, metalloenzymes, abzymes, and ribozymes. Classification of enzymes based on IUBMB with examples.**Units of enzyme activity**: Specific activity and enzyme turnover number.Enzyme specificity, and the concept of an active site.
Theories of enzyme catalysis-lock and key model, Koshland's induced fit theory.
Enzyme Kinetics: Factors affecting the rate of enzyme-catalyzed reactions**:** Effect of substrate concentration, pH, and temperature. Michaelis-Menten equation (derivation not required). Lineweaver-Burk (L-B) plot.Determination of Km &Vmax from L-B plot and their significance.

Unit-2: Enzyme inhibition: 16 Hrs
Competitive, noncompetitive, and uncompetitive inhibition with suitable examples.Graphical representation by L-B plot, effect of inhibitor on Km &Vmax using LB plot.Irreversible inhibition—suicide inhibition.
Allosteric enzymes, Isoenzymes, Multienzyme complex:
Allosteric enzymes-characteristics with PFKand ATCase as examples.
Isoenzymes-Properties & and biological role of LDH and Creatine Kinase
Multienzyme complex: Pyruvate dehydrogenase complex and Fatty acyl CoA synthase-subunit composition & biological role.
Applications of enzymes: Industrial & Medical applications.

Unit-3: Metabolism I 16hrs
Introduction to metabolism: Catabolism, anabolism, compartmentalization of metabolic pathways.
Metabolism of Carbohydrates: Reactions and energetics of glycolysis, entry of fructose, galactose, mannose, and lactose into glycolytic pathway. Fates of pyruvate: conversion of pyruvate to lactate, alcohol, and acetyl CoA. Cori cycle and futile cycle**.Reactions and energetics of the TCA cycle,**Amphibolic and integrating roles of the TCA cycle. Anapleroticreactions. Regulatory steps of glycolysis and the TCA cycle. **Gluconeogenesis** pathway and significance.**Pentose phosphate pathway** and its significance.**Glycogen metabolism:** Glycogenolysis, glycogenesis & regulation.

References:

- *Lehninger Principles of Biochemistry, 1 - 6th Editions,*
- *Biochemistry. By LubertStryer, 1- 6th Editions*
- *Stryer Biochemistry 4th Ed. (1995) W.H. Freeman Co., San Francisco, USA*
- *G.L. Zubay BIOCHEMISTRY 4th Ed. (1998) W.C. Brown Publishers, USA.*
- *Voet, D and Voet, J.G, (2009) Biochemistry, John Wiley and Sons, N.Y. USA.*
- *Garret, R.H. and Grisham, C.M. (2005) Biochemistry, 3rd Edition. Thomson Learning INC.*
- *U.Satyanarayana and U.Chakrapani, Biochemistry, CBS Publishers and Disributors, 7th Edition*
- *DMVasudevan, Srikumari.S, KannanVaidyanathan, Textbook of Biochemistry for Medical students, 11th edition*

B.Sc. IV SEMESTER (SEP)
ENZYMOLOGY
COURSE CODE: DSC-4P SEPBC-402

COURSE TITLE	**ENZYMOLOGY**
COURSE CODE	**DSC-4P SEPBC-402**
COURSE CREDITS	02
TYPE OF THE COURSE	PRACTICAL
TOTAL CONTACT HOURS	64 HOURS (4 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

Enzyme assay of alpha amylase/ Salivary amylase/β- amylase/ diastase

1. Construction of Maltose/glucose calibration curve by DNS method and determination of activity of amylase
2. Determination of specific activity of amylase
3. Determination of pH optimum of amylase.
4. Determination of Km and Vmax of amylase.
5. Determination of initial velocity [time kinetics] of amylase.
6. Determination of optimum temperature of amylase.
7. Effect of sodium chloride on amylase.
8. Effect of enzyme concentration.
9. Determination of activity of yeast invertase.
10. Isolation of Urease and demonstration of its activity.
11. Isolation of Acid phosphatase and demonstration of its activity.

B.Sc. IV SEMESTER (SEP)(SKILL ENHANCEMENT COURSE)
NUTRITION
COURSE CODE: SEC-1 SEPBC-403

COURSE TITLE	**NUTRITION**
COURSE CODE	**SEC-1SEPBC-403**
COURSE CREDITS	02
TYPE OF THE COURSE	PRACTICAL
TOTAL CONTACT HOURS	64 (4 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

1. Working of Bomb calorimeter.
2. Calculation of BMR.
3. Qualitative assessment of reducing sugars, starch, proteins, amino acids in a food sample.
4. Quantitative assessment of proteins in a dietary sample.
5. Quantitative assessment of amino acids in a food sample.
6. Qualitative assessment of lipids.
7. Isolation of oils from food samples using Soxhlet Apparatus.
8. Estimation of peroxide value of an oil sample.
9. Estimation of iodine number of an oil sample.
10. Estimation of acid value of an oil sample.
11. Qualitative assessment of food adulterants (Any two out of: Butter yellow, lead chromate & malachite green).

B.Sc. IV SEMESTER (SEP) (SKILL ENHANCEMENT COURSE)
PLANT BIOCHEMISTRY
COURSE CODE: SEC-2 SEPBC-404

COURSE TITLE	**PLANT BIOCHEMISTRY**
COURSE CODE	**SEC-2 SEPBC-404**
COURSE CREDITS	02
TYPE OF THE COURSE	PRACTICAL
TOTAL CONTACT HOURS	64 (4 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

1. In situ staining of starch using Iodine, in a leaf section or layer, or plant tissue section.
2. Ascending paper chromatography for plant pigments (test tube method/ beaker method).
3. Reduction of DCPIP by plant tissue or leaf homogenate.
4. Qualitative assessment of Catalase enzyme activity.
5. Effect of pH on anthocyanins (ex. Beet juice, rose flower juice)
6. Qualitative assessment of flavonoids using aluminium chloride method.
7. Quantitative estimation of phenols or polyphenols using FC method.
8. Qualitative assessment of tannins.
9. Qualitative assessment of alkaloids.
10. Qualitative assessment of saponins.

REFERENCES:

1. Lehninger's Principles of Biochemistry - Nelson & Cox. CBS Publishers & Distributors, 2013
2. Principles of Biochemistry - Moran, Horton, Scrimgeour, Perry. Pearson, 5thEdition , 2011
3. Plant Biochemistry - P.M. Dey& J.B. Harborne. Hart Court Asia Pvt Ltd. 1997
4. Plant Biochemistry and Molecular Biology - P. Lea & Richard C Leegood., John Wiley & Sons. 1999
5. Introduction to Plant Biochemistry - Goodwin and Mercer. CBS Publisher and Distributors. 2005
6. Biochemistry and Molecular Biology of Plants - Buchanan, Greussem and Jones. American Society of Plant Physiologists. 2000
7. Natural Products from plants. Peter B. Kaufman, Leland J. Cseke, Sara Warber, James A. Duke, Harry L. Brielmann, CRC Press, Boca Raton 1999.
8. Natural Products Targeting Clinically Relevant Enzymes. Paula B. Andrade, Patricia Valentao David M. Pereira. Wiley-VCHVerlag GmbH & Co 2017
9. Plant Cell Tissue and Organ Culture: Fundamental Methods - O.L. Gamborg&G.C. Phillips Narosa Publishers, New Delhi, 1995.
10. Kant R. Sweet proteins – Potential replacement for artificial low calorie sweeteners. Nutrition J. 2005; 4:5 doi:10.1186/1475-2891-4-5.

B.Sc. V SEMESTER (SEP)
METABOLISM II AND CLINICAL BIOCHEMISTRY
COURSE CODE: DSC-5T SEPBC-501

COURSE TITLE	**METABOLISM II AND CLINICAL BIOCHEMISTRY**
COURSE CODE	**DSC-5T SEPBC-501**
COURSE CREDITS	03
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	48 (3 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Unit I: Bioenergetics and amino acid metabolism 16Hrs

Bioenergetics:I and II laws of thermodynamics, Concept of enthalpy, entropy, freeenergy,equilibrium constant, Standard free energy change.Phosphorylation potential, and phosphoryl group transfers. ATP-ADP cycle. High energy compounds (PEP, 1,3, BPG and Thioesters). Chemical basis of high standard energy of hydrolysis of ATP.Outlines of substrate-level phosphorylation with examples.**Oxidative phosphorylation:** General electron carriers. Electron transport chain.Its, organization and function.Q cycle, and proton pumping, redox loop.**Peter Mitchell's chemiosmotic hypothesis** and proton motive force. Fo-F1 ATP synthase: Structure and mechanism of ATP synthesis. P/O ratio.**Uncouplers and inhibitors of respiration:** Rotenone, Antimycin A, Cyanide, and 2,4-DNP.

Aminoacid Metabolism: Protein turnover, General mechanism of amino acid metabolism: Deamination- oxidative and non – oxidative deamination, transamination, decarboxylation (biologically important amines) and desulphuration. Catabolism of carbon skeleton of amino acids, glycogenic and ketogenic amino acids.Urea cycle and its significance.Synthesis and catabolism of alanine, serine and cysteine.

Unit II: Metabolism of lipids and Nucleic acids 16 Hrs

Metabolism of Lipids: Degradation of triacyl glycerol and phospholipids- action of lipases and phosholipases. Fatty acid degradation and types. Transport of fatty acids to mitochondria, β-oxidation of even numbered saturated fatty acid. Energetics of β-oxidation with an example. Outline of biosynthesis of even numbered saturated fatty acids, Fatty acid synthase complex. Outline of Biosynthesis of cholesterol. Regulation of cholesterol biosynthesis.(Structures not necessary). Outline of metabolism of lipoproteins. Reverse cholesterol transport. Metabolism of ketone bodies: Formation, utilization and importance.

Nucleic Acid metabolism: Degradation of nucleic acids, action of nucleases-DNase I and II, RNase and phosphodiesterases. Catabolism of purines and pyrimidines. Salvage pathway. De novo biosynthetic pathway of purine and pyrimidine nucleotides (Structures not necessary).Conversion of ribonucleotides to deoxyribonucleotides. Inhibitorsof nucleotide biosynthesis: methotrexate,5FU.

Unit III: Clinical Biochemistry **16 Hrs**

Introduction: Basic concept of clinical biochemistry - Definition and scope of clinical biochemistry in diagnosis, quality control-external and internal quality controll, accuracy, precision, specificity. Collection and preservation of blood and urine**.**

Disorders:Carbohydrate metabolism: Blood sugar level and its clinical significance-Hypo and hyperglycemia. Diabetes mellitus-defintion, clinical features, biochemical and metabolic changes(in brief). Glycogen storage diseases, Frucosuria, Galactosemia. L**ipid metabolism:** Atherosclerosis, Niemann Pick disease, Gaucher's disease.**Amino acid metabolism-**Alkaptonuria and phenylketonuria.**purinemetaboism:** Gout, LeschNyhan syndrome.

Liver: Jaundice, hemolytic, hepatic and obstructive jaundice. Conjugated and unconjugatedbilirubin, bile pigment levels in blood and urine.

Clinical Enzymology: Functionaland non functional plasma enzymes, isozymes and diagnostic tests. Enzyme pattern in health and diseases, LDH, CPK, SGOT&SGPT and Troponin

References:

- *Lehninger Principles of Biochemistry, 1 - 6th Editions,*
- *Biochemistry. By LubertStryer, 1- 6th Editions*
- *Stryer Biochemistry 4th Ed. (1995) W.H. Freeman Co., San Francisco, USA*
- *G.L. Zubay BIOCHEMISTRY 4th Ed. (1998) W.C. Brown Publishers, USA.*
- *Voet, D and Voet, J.G, (2009) Biochemistry, John Wiley and Sons, N.Y. USA.*
- *Garret, R.H. and Grisham, C.M. (2005) Biochemistry, 3rd Edition. Thomson Learning INC.*
- *U.Satyanarayana and U.Chakrapani, Biochemistry, CBS Publishers and Disributors, 7th Edition*
- *DMVasudevan, Srikumari.S, KannanVaidyanathan, Textbook of Biochemistry for Medical students, 11th edition*
- *Thomas M Devlin, Textbook of Biochemistry with Clinical Correlations, Jhon Wiley and Sons inc. 6th Edition*
- *Michael Murphy, Rajeev Srivastava, Kevin Deans, Clinical Biochemistry,Elsevier, 7th Edition*
- *Nessar Ahmed, Clinical Biochemistry, OUP Oxford, 2nd Edition*

B.Sc. V SEMESTER (SEP)
MOLECULAR BIOLOGY AND GENETIC ENGINEERING
COURSE CODE: DSC-6T SEPBC-502

COURSE TITLE	**MOLECULAR BIOLOGY AND GENETIC ENGINEERING**
COURSE CODE	**DSC-6T SEPBC-502**
COURSE CREDITS	03
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	48 (3 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

UnitI **16 Hrs**

Introduction - DNA as a genetic material, Griffith and Hershey, Chase experiment. Degradation of nucleic acids- pancreatic RNase, phosphodiesterase, DNase I & II.

DNA Replication - Types of replications (conservative, semi conservative and dispersive). Experimental verification of semiconservative mode of replication. Enzymes involved in replication. Mechanism of replication in prokaryotes, origin and replication fork, role of DNA polymerase.Discontinuous DNA synthesis.RNA primer in DNA synthesis.DNA ligase and its role.RNA replication- Role of RNA replicase.

Mutation - Concepts of mutation, Mutagens (chemical and physical), Molecular basis of mutation: spontaneous and induced mutation, effects of HNO_2 and UV- radiations, Point mutations: concept of missense, nonsense and frame shift mutation.

Unit II **16Hrs**

Transcription in Prokaryotes: Transcription factors and machinery, formation of initiation complex, activators and repressors, Role of RNA polymerase, elongation and termination. Reverse transcription

Genetic code: General features, coding properties of t-RNA, wobble hypothesis.

Translation in Prokaryotes: A brief account of ribosome's, activation of amino acid. Formation of Initiation complex, elongation and termination. Post translational modification and inhibitors of protein synthesis.

Gene regulation: Regulation of gene expression in prokaryotes and its types, Operon concept- *Lac* operon, *Trp*operon.

Unit III **16Hrs**

Genetic Engineering- Brief history and principles of genetic engineering, molecular tools of genetic engineering- Enzymes used in Recombinant DNA technology (r-DNA) technology - Types, detail account of restriction endonuclease- types and their functions, ligase**.** Vectors (cloning vehicles) -Salient features of vectors, plasmids, bacteriophage, cosmid, artificial chromosomal vectors. Methods of gene transfer- Transformation, Conjugation, Electroporation, Liposome mediated gene transfer and direct transfer of DNA

Gene cloning strategies- Cloning from genomic DNA - Construction of chimeric DNA.Introduction of chimeric vectors to the host cell.Selection of transformed cell by replica plating. Genomic library and its construction, c-DNA synthesis

Basic techniques in genetic engineering- Blotting techniques - Types (Southern, Northern and Western) and their applications. DNA sequencing method-PCR: Principle, procedure and applications. Microarray of gene probes, DNA finger printing, DNA markers in diseases, RFLP, VNTR and SNP's.

Applications of r-DNA technology- Insulin in Diabetes, Recombinant vaccines, transgenic animals, transgenic plants, Human genome project, gene therapy.
Advantages and disadvantages of r-DNA technology in society.

REFERENCES

1. Molecular Biology of Gene; Watson, J.D. et al., 5th Edn. Pearson Education; (2004).
2. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring HarborLab.Press, Pearson Pub.
3. Lewins Gene XII; J.E. Krebs, E.S. Goldstein, and S.T. Kilpatrick, Jones and Barlett Publishers (2018).
4. Molecular Biology; Robert F. Weaver, McGraw-Hill (2018).
5. Genome 2; T.A. Brown, John Wiley & sons (2002).
6. Lehninger principles of biochemistry.Freeman, 2013. LubertStryer. Biochemistry, 5th edition, 2006
7. Owen, Judith A., Jenni Punt, and Sharon A. Stranford. Kuby immunology. New York: WH Freeman, 2013.
8. Molecular Biology–David Friefelder, Narosa Publication House Pvt.Ltd..New Delhi,2020
9. Principles of Biochemistry, DonaldVoet, Judith G

B.Sc. V SEMESTER (SEP)
METABOLISM AND CLINICAL BIOCHEMISTRY
COURSE CODE: DSC-5P SEPBC-503

COURSE TITLE	**METABOLISM AND CLINICAL BIOCHEMISTRY**
COURSE CODE	**DSC-5P SEPBC-503**
COURSE CREDITS	02
TYPE OF THE COURSE	PRACTICAL
TOTAL CONTACT HOURS	64 HOURS (4 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

12. Estimation of protein by Biuret method.
13. Estimation of protein by Lowry's method.
14. Estimation of sugar by Folin-Wu method.
15. Estimation of Urea by DAMO method.
16. Estimation of Keto acid by DNPH method.
17. Determination of Uric acid.
18. Estimation of phosphate by Fiske-Subbarao method.
19. Determination of activity of SGPT.
20. Qualitative tests of urine for normal and abnormal constituents.
21. Estimation of RNA by Orcinol method.
22. Report: Visit to scientific / research institute-Tour report.
Or, INTERNSHIP,
Or, any other alternative assignment decided by the department.

ELECTIVE COURSES CAN BE OFFERED AS PER 3RD AND 4TH SEMESTERS WITHOUT REPETITION.

B.Sc. VI SEMESTER (SEP)
HUMAN PHYSIOLOGY
COURSE CODE: DSC-7T SEPBC-601

COURSE TITLE	**HUMAN PHYSIOLOGY**
COURSE CODE	**DSC-7T SEPBC-601**
COURSE CREDITS	03
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	48 (3 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

UNIT I: **16 Hrs**

Introduction to Human Physiology

Overview and definition; levels of structural organization and organ system.Homeostasis and control mechanisms (negative and positive feedback mechanisms)**.**

Nervous system: Types of neurons, generalized structure of multipolar neuron. Resting membrane potential, Action potential, Transmission of nerve impulse along an axon and across a synapse.Neurotransmitters (Excitatory and inhibitory) and inhibitors of neurotransmission.

Respiratory system: Anatomy and functions of respiratory system, structure and functions of lungs, gas exchange mechanism, biochemical events in the transport of gases & factors affecting, Oxygen dissociation curve, Chloride shift, Haldane and Bohr's effect, role of lungs in acid-base balance.

Cardio-vascular system: Structure and functions of heart. Blood vessels–types, Overview & functions: Cardiac cycle, cardiac output, regulation of CVS, blood pressure, heart rate, ECG.

UNIT II: **16 Hrs**

Skeletal system: Types of muscles. Ultrastructure of skeletal muscle.Contractile and regulatory proteins of muscle.Sliding filament model of skeletal muscle contraction.

Bone: Classification of bones; Long bone -Composition and structure of long bone, growth and remodelling of long bone. Factors affecting its growth.

Excretory system: Structure of the Nephron, formation of urine – Glomerular filtration, tubular reabsorption and secretions. Role of kidney in acid base balance.

Body fluids: Blood volume, composition and functions, RBC, WBC and platelets: structure and functions. Types of plasma proteins and their function.Mechanism of blood coagulation (intrinsic and extrinsic pathway).Anticoagulants. Composition and function: Cerebrospinal fluid and Lymph. Blood brain Barrier. Blood buffers-types, composition and function. Sickle cell anaemia and Thalassemia

UNIT III: **16 Hrs**

Digestive System and GIT: Anatomy of GIT and accessory organs. Composition and function of saliva, gastric juice, intestinal juice, bile juice, pancreatic juice. Gastric motility-peristalsis, segmentation and sphincter control. Digestion, absorption and transportation of carbohydrates, proteins and lipids.Hormones of GIT.

Liver: Structure of a lobule, functions – metabolic, storage and detoxification.

Endocrine system: Organisation of endocrine system -Endocrine glands and their secretions, classification of hormones based on structure and site of production**.**Hierarchy, interplay, dynamic balance and regulation of hormone secretions.Functions of the hormones of Hypothalamus, Pituitary (GH, ACTH, TSH, FSH, LH, oxytocin and ADH), Adrenal (Aldosterone, Cortisol & Cortisone), Thyroid (T3&T4), Pancreas (Insulin and Glucagon) and Gonads (testosterone, estradiol and progesterone).Hypo and hyper production of hormones.General mechanism of peptide and steroid hormone action.Concept of second messengers.Eg: cAMP, DAG, IP3, G-protein.

FROM 2027-28 ONWARDS

(THIS 3-CREDIT COURSE IS FOR ONLY THE BATCH WHICH WILL BE PROMOTED IN JUNE-AUGUST2027 FROM 4THSEM TO 5THSEM, AND THE SUBSEQUENT BATCHES)

B.Sc. VI SEMESTER (SEP)

IMMUNOLOGY AND TOXICOLOGY

COURSE CODE: DSC-8T SEPBC-604

COURSE TITLE	**IMMUNOLOGY AND TOXICOLOGY**
COURSE CODE	**DSC-8T SEPBC-604**
COURSE CREDITS	03
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	48 (3 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Unit I **16Hrs**

Introduction: Cells and Organs of immune system: Primary and secondary lymphoid organs, Bone marrow, Thymus, Spleen. Lymphoid cells, T lymphocytes, types and B lymphocytes, null cells, Mononuclear cells, Macrophages and Granulocytic cells.

Immunity: Innate and adaptive immunity. Innate immunity (non-specific), -Anatomic, physical, phagocytic and inflammatory barriers. Adaptive (specific) immunity: Active and Passive immunity. Formation and functions of T and B lymphocytes (In brief). Humoral and cell mediated immunity. Recognition of antigens by T and B lymphocytes, Processing and presentation of antigens.

Antigens: Types, characteristics, antigenicity, immunogenicity, Immunogens and factors influencing immunogenicity, epitopes, haptens and adjuvants.

Unit II **16 Hrs**

Immunoglobins: Generalised structure of antibody, classes and functions of immunoglobulins. Antigenic determinants of immunoglobulins.Theories of antibody production, clonal expansion theory.Monoclonal antibodies and its production by any one method and applications.Polyclonal antibodies.

T and B lymphocytes: T cell receptors, maturation, activation and differentiation. B-cell receptors, maturation, activation and proliferation.Cytokines- Interferon and Interleukins, importance and functions.

Immunological techniques: Antigen antibody reactions-precipitation and agglutination reactions in immunodiffusion (Ouchterlony and Radial Immunodiffusion), immunoelectrophoresis. ELISA, RIA.

Hypersensitivity reactions: Definition,Types (I, II, III, IV and V), based on time and symptoms.

Vaccines-Types, Active and passive immunization, preparation of vaccines (Rabies vaccine).

Auto immune disorders: Definition,Rheumatoid arthritis, Myasthenia gravis, Parkinson disease.

Unit III **16 Hrs**

Toxicology: Scope of toxicology. Toxins and toxicants. Classification of toxins based on source, target system. Toxicity-influencing factors: Species and strains, age, sex, nutritional status, hormones, circadian rhythms and environmental factors. Dose-response relationships, synergism, and antagonism.Determination of ED50 and LD50.Acute and chronic exposure.

Toxicokinetics: Absorption and transportation. Mechanism of Toxicity: Organophosphates, Mercury, Aflatoxins. Antidotal Therapy for Toxins: Types. Procedures that decrease the absorption and translocation of toxicants.Physical removal of poisons by emetics, gastric lavage, and cathartics.Drugs for the deactivation of toxins.

B.Sc. VI SEMESTER (SEP)
PHYSIOLOGY AND IMMUNOLOGY
COURSE CODE: DSC-6P SEPBC-603

COURSE TITLE	**PHYSIOLOGY AND IMMUNOLOGY**
COURSE CODE	**DSC-6P SEPBC-603**
COURSE CREDITS	02
TYPE OF THE COURSE	PRACTICAL
TOTAL CONTACT HOURS	64 HOURS (4 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

1. Estimation of amino acid by Ninhydrin method.
2. Estimation of Cholesterol by Zak's method.
3. Estimation of titrable acidity in urine.
4. Estimation of amino acid by Sorenson's formal titration method.
5. Estimation of Calcium in serum.
6. Estimation of Inorganic phosphorus by Fiske Subbarao method.
7. Estimation of Creatinine by Jaffe's method.
8. Determination of Clotting time and Bleeding time.
9. Blood typing.
10. Determination of % of Haemoglobin.
11. Estimation of Iron by Wong's method.
12. Radial immunodiffusion/ Ouchterlony double diffusion.
13. Determination of RBC and WBC count by Haemocytometer.

ELECTIVE COURSES CAN BE OFFERED AS PER 3RD AND 4TH SEMESTERS WITHOUT REPETITION.

SCHEME OF PRACTICAL EXAMS

COURSE CREDITS	**02**
TYPE OF THE COURSE	**PRACTICAL**
TOTAL CONTACT HOURS	**64 HOURS (4 HOURS/ WEEK)**
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	**03**
FORMATIVE ASSESSMENT MARKS	**(5+5= 10)**
SUMMATIVE ASSESSMENT MARKS	**40**

C1 and C2 are internal tests to be conducted during 8th and 16th weeks respectively of the semester. The student has to compulsorily submit the practical record during C1and C2. C3 is the semester-end examination conducted for 3 hours. The students will be evaluated on the basis of skill, comprehension and recording the results. For C3, Students must submit completed practical records duly signed by batch teachers and certified by HOD at the time of examination.

The student is evaluated for C1 and C2 respectively as per the following scheme:

Heading Marks C1: Test – Conduction of Experiment 05

C2: Record + test 05

Total =10

The student is evaluated for 40 marks in C3 as per the following scheme.

PART- A: Procedure writing, Marks – 05

PART- B: Major Experiment, Marks – 20

PART- C: Minor Experiment and

(Practical record/ Industry visit report/ internship report), Marks – 10

PART- D: Viva Voce, Marks – 05

THEORY EXAMS (FOR 3 CREDIT PAPERS)

COURSE CREDITS	03
TYPE OF THE COURSE	THEORY
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

THEORY EXAMS (FOR 3 CREDIT PAPERS)

COURSE CREDITS	**02**
TYPE OF THE COURSE	**THEORY**
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	**02**
FORMATIVE ASSESSMENT MARKS	**10**
SUMMATIVE ASSESSMENT MARKS	**40**

C1 and C2, can be

- **Test**
- **Quiz**
- **Assignment, Report**
- **Seminar**

C3 - END SEMESTER EXAM

The scheme of theory exam will be as previously approved.

Syllabus for B.Sc. Biochemistry- 5 & 6 Semesters

FOR 2026-27 BATCH

THE BATCHES WHICH ARE ENTERING 5thSEMESTER

DURING JULY-AUGUST 2026

SEM	COURSE TITLE	TYPE	CODE	CREDITS
5	**METABOLISM II AND CLINICAL BIOCHEMISTRY**	THEORY	DSC-5T	3
	MOLECULAR BIOLOGY AND GENETIC ENGINEERING	THEORY	DSC-6T	3
	METABOLISM AND CLINICAL BIOCHEMISTRY	PRACTICAL	DSC-5P	2
6	**HUMAN PHYSIOLOGY**	THEORY	DSC-7T	3
	IMMUNOLOGY	THEORY	DSC-8T	2
	PHYSIOLOGY AND IMMUNOLOGY	PRACTICAL	DSC-6P	2

B.Sc. V SEMESTER (SEP)
METABOLISM II AND CLINICAL BIOCHEMISTRY
COURSE CODE: DSC-5T SEPBC-501

COURSE TITLE	**METABOLISM II AND CLINICAL BIOCHEMISTRY**
COURSE CODE	**DSC-5T SEPBC-501**
COURSE CREDITS	03
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	48 (3 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Unit I: Bioenergetics and amino acid metabolism 16Hrs

Bioenergetics:I and II laws of thermodynamics, Concept of enthalpy, entropy, freeenergy,equilibrium constant, Standard free energy change.Phosphorylation potential, and phosphoryl group transfers. ATP-ADP cycle. High energy compounds (PEP, 1,3, BPG and Thioesters). Chemical basis of high standard energy of hydrolysis of ATP.Outlines of substrate-level phosphorylation with examples.**Oxidative phosphorylation:** General electron carriers. Electron transport chain.Its, organization and function.Q cycle, and proton pumping, redox loop.**Peter Mitchell's chemiosmotic hypothesis** and proton motive force. Fo-F1 ATP synthase: Structure and mechanism of ATP synthesis. P/O ratio.**Uncouplers and inhibitors of respiration:** Rotenone, Antimycin A, Cyanide, and 2,4-DNP.

Aminoacid Metabolism: Protein turnover, General mechanism of amino acid metabolism: Deamination- oxidative and non – oxidative deamination, transamination, decarboxylation (biologically important amines) and desulphuration. Catabolism of carbon skeleton of amino acids, glycogenic and ketogenic amino acids.Urea cycle and its significance.Synthesis and catabolism of alanine, serine and cysteine.

Unit II: Metabolism of lipids and Nucleic acids 16 Hrs

Metabolism of Lipids: Degradation of triacyl glycerol and phospholipids- action of lipases and phosholipases. Fatty acid degradation and types. Transport of fatty acids to mitochondria, β-oxidation of even numbered saturated fatty acid. Energetics of β-oxidation with an example. Outline of biosynthesis of even numbered saturated fatty acids, Fatty acid synthase complex. Outline of Biosynthesis of cholesterol. Regulation of cholesterol biosynthesis.(Structures not necessary). Outline of metabolism of lipoproteins. Reverse cholesterol transport. Metabolism of ketone bodies: Formation, utilization and importance.

Nucleic Acid metabolism: Degradation of nucleic acids, action of nucleases-DNase I and II, RNase and phosphodiesterases. Catabolism of purines and pyrimidines. Salvage pathway. De novo biosynthetic pathway of purine and pyrimidine nucleotides (Structures not necessary).Conversion of ribonucleotides to deoxyribonucleotides. Inhibitorsof nucleotide biosynthesis: methotrexate,5FU.

Unit III: Clinical Biochemistry **16 Hrs**

Introduction: Basic concept of clinical biochemistry - Definition and scope of clinical biochemistry in diagnosis, quality control-external and internal quality controll, accuracy, precision, specificity. Collection and preservation of blood and urine**.**

Disorders:Carbohydrate metabolism: Blood sugar level and its clinical significance-Hypo and hyperglycemia. Diabetes mellitus-defintion, clinical features, biochemical and metabolic changes(in brief). Glycogen storage diseases, Frucosuria, Galactosemia. L**ipid metabolism:** Atherosclerosis, Niemann Pick disease, Gaucher's disease.**Amino acid metabolism-**Alkaptonuria and phenylketonuria. P**urine metaboism:** Gout, LeschNyhan syndrome.

Liver: Jaundice, hemolytic, hepatic and obstructive jaundice. Conjugated and unconjugatedbilirubin, bile pigment levels in blood and urine.

Clinical Enzymology: Functionaland non functional plasma enzymes, isozymes and diagnostic tests. Enzyme pattern in health and diseases, LDH, CPK, SGOT&SGPT and Troponin

References:

- *Lehninger Principles of Biochemistry, 1 - 6th Editions,*
- *Biochemistry. By LubertStryer, 1- 6th Editions*
- *Stryer Biochemistry 4th Ed. (1995) W.H. Freeman Co., San Francisco, USA*
- *G.L. Zubay BIOCHEMISTRY 4th Ed. (1998) W.C. Brown Publishers, USA.*
- *Voet, D and Voet, J.G, (2009) Biochemistry, John Wiley and Sons, N.Y. USA.*
- *Garret, R.H. and Grisham, C.M. (2005) Biochemistry, 3rd Edition. Thomson Learning INC.*
- *U.Satyanarayana and U.Chakrapani, Biochemistry, CBS Publishers and Disributors, 7th Edition*
- *DMVasudevan, Srikumari.S, KannanVaidyanathan, Textbook of Biochemistry for Medical students, 11th edition*
- *Thomas M Devlin, Textbook of Biochemistry with Clinical Correlations, Jhon Wiley and Sons inc. 6th Edition*
- *Michael Murphy, Rajeev Srivastava, Kevin Deans, Clinical Biochemistry,Elsevier, 7th Edition*
- *Nessar Ahmed, Clinical Biochemistry, OUP Oxford, 2nd Edition*

B.Sc. V SEMESTER (SEP)
MOLECULAR BIOLOGY AND GENETIC ENGINEERING
COURSE CODE: DSC-6T SEPBC-502

COURSE TITLE	**MOLECULAR BIOLOGY AND GENETIC ENGINEERING**
COURSE CODE	**DSC-6T SEPBC-502**
COURSE CREDITS	03
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	48 (3 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Unit I **16 Hrs**

Introduction - DNA as a genetic material, Griffith and Hershey, Chase experiment. Degradation of nucleic acids- pancreatic RNase, phosphodiesterase, DNase I & II.

DNA Replication - Types of replications (conservative, semi conservative and dispersive). Experimental verification of semiconservative mode of replication. Enzymes involved in replication. Mechanism of replication in prokaryotes, origin and replication fork, role of DNA polymerase.Discontinuous DNA synthesis.RNA primer in DNA synthesis.DNA ligase and its role.RNA replication- Role of RNA replicase.

Mutation - Concepts of mutation, Mutagens (chemical and physical), Molecular basis of mutation: spontaneous and induced mutation, effects of HNO_2 and UV- radiations, Point mutations: concept of missense, nonsense and frame shift mutation.

Unit II **16Hrs**

Transcription in Prokaryotes: Transcription factors and machinery, formation of initiation complex, activators and repressors, Role of RNA polymerase, elongation and termination. Reverse transcription

Genetic code: General features, coding properties of t-RNA, wobble hypothesis.

Translation in Prokaryotes: A brief account of ribosome's, activation of amino acid. Formation of Initiation complex, elongation and termination. Post translational modification and inhibitors of protein synthesis.

Gene regulation: Regulation of gene expression in prokaryotes and its types, Operon concept- *Lac* operon, *Trp*operon.

Unit III **16Hrs**

Genetic Engineering- Brief history and principles of genetic engineering, molecular tools of genetic engineering- Enzymes used in Recombinant DNA technology (r-DNA) technology - Types, detail account of restriction endonuclease- types and their functions, ligase**.** Vectors (cloning vehicles) -Salient features of vectors, plasmids, bacteriophage, cosmid, artificial chromosomal vectors. Methods of gene transfer- Transformation, Conjugation, Electroporation, Liposome mediated gene transfer and direct transfer of DNA

Gene cloning strategies- Cloning from genomic DNA - Construction of chimeric DNA.Introduction of chimeric vectors to the host cell.Selection of transformed cell by replica plating. Genomic library and its construction, c-DNA synthesis

Basic techniques in genetic engineering- Blotting techniques - Types (Southern, Northern and Western) and their applications. DNA sequencing method-PCR: Principle, procedure and applications. Microarray of gene probes, DNA finger printing, DNA markers in diseases, RFLP, VNTR and SNP's.

Applications of r-DNA technology- Insulin in Diabetes, Recombinant vaccines, transgenic animals, transgenic plants, Human genome project, gene therapy.
Advantages and disadvantages of r-DNA technology in society.

REFERENCES

1. Molecular Biology of Gene; Watson, J.D. et al., 5th Edn. Pearson Education; (2004).
2. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring HarborLab.Press, Pearson Pub.
3. Lewins Gene XII; J.E. Krebs, E.S. Goldstein, and S.T. Kilpatrick, Jones and Barlett Publishers (2018).
4. Molecular Biology; Robert F. Weaver, McGraw-Hill (2018).
5. Genome 2; T.A. Brown, John Wiley & sons (2002).
6. Lehninger principles of biochemistry.Freeman, 2013. LubertStryer. Biochemistry, 5th edition, 2006
7. Owen, Judith A., Jenni Punt, and Sharon A. Stranford. Kuby immunology. New York: WH Freeman, 2013.
8. Molecular Biology–David Friefelder, Narosa Publication House Pvt.Ltd..New Delhi,2020
9. Principles of Biochemistry, DonaldVoet, Judith G

B.Sc. V SEMESTER (SEP)
METABOLISM AND CLINICAL BIOCHEMISTRY
COURSE CODE: DSC-5P SEPBC-503

COURSE TITLE	**METABOLISM AND CLINICAL BIOCHEMISTRY**
COURSE CODE	**DSC-5P SEPBC-503**
COURSE CREDITS	02
TYPE OF THE COURSE	PRACTICAL
TOTAL CONTACT HOURS	64 HOURS (4 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

1. Estimation of protein by Biuret method.
2. Estimation of protein by Lowry's method.
3. Estimation of sugar by Folin-Wu method.
4. Estimation of Urea by DAMO method.
5. Estimation of Keto acid by DNPH method.
6. Determination of Uric acid.
7. Estimation of phosphate by Fiske-Subbarao method.
8. Determination of activity of SGPT.
9. Qualitative tests of urine for normal and abnormal constituents.
10. Estimation of RNA by Orcinol method.
11. **Report:** Visit to scientific/research institute-Tour report.
    Or, INTERNSHIP,
    Or, any other alternative assignment decided by the department.

ELECTIVE COURSES CAN BE OFFERED AS PER 3RD AND 4TH SEMESTERS WITHOUT REPETITION.

B.Sc. VI SEMESTER (SEP)
HUMAN PHYSIOLOGY
COURSE CODE: DSC-7T SEPBC-601

COURSE TITLE	**HUMAN PHYSIOLOGY**
COURSE CODE	**DSC-7T SEPBC-601**
COURSE CREDITS	03
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	48 (3 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

UNIT I: **16 Hrs**

Introduction to Human Physiology

Overview and definition; levels of structural organization and organ system.Homeostasis and control mechanisms (negative and positive feedback mechanisms)**.**

Nervous system: Types of neurons, generalized structure of multipolar neuron. Resting membrane potential, Action potential, Transmission of nerve impulse along an axon and across a synapse.Neurotransmitters (Excitatory and inhibitory) and inhibitors of neurotransmission.

Respiratory system: Anatomy and functions of respiratory system, structure and functions of lungs, gas exchange mechanism, biochemical events in the transport of gases & factors affecting, Oxygen dissociation curve, Chloride shift, Haldane and Bohr's effect, role of lungs in acid-base balance.

Cardio-vascular system: Structure and functions of heart. Blood vessels–types, Overview & functions: Cardiac cycle, cardiac output, regulation of CVS, blood pressure, heart rate, ECG.

UNIT II: **16 Hrs**

Skeletal system: Types of muscles. Ultrastructure of skeletal muscle.Contractile and regulatory proteins of muscle.Sliding filament model of skeletal muscle contraction.

Bone: Classification of bones; Long bone -Composition and structure of long bone, growth and remodelling of long bone. Factors affecting its growth.

Excretory system: Structure of the Nephron, formation of urine – Glomerular filtration, tubular reabsorption and secretions. Role of kidney in acid base balance.

Body fluids: Blood volume, composition and functions, RBC, WBC and platelets: structure and functions. Types of plasma proteins and their function.Mechanism of blood coagulation (intrinsic and extrinsic pathway).Anticoagulants. Composition and function: Cerebrospinal fluid and Lymph. Blood brain Barrier. Blood buffers-types, composition and function. Sickle cell anaemia and Thalassemia

UNIT III: 16 Hrs

Digestive System and GIT: Anatomy of GIT and accessory organs. Composition and function of saliva, gastric juice, intestinal juice, bile juice, pancreatic juice. Gastric motility-peristalsis, segmentation and sphincter control. Digestion, absorption and transportation of carbohydrates, proteins and lipids.Hormones of GIT.

Liver: Structure of a lobule, functions – metabolic, storage and detoxification.

Endocrine system: Organisation of endocrine system -Endocrine glands and their secretions, classification of hormones based on structure and site of production**.**Hierarchy, interplay, dynamic balance and regulation of hormone secretions.Functions of the hormones of Hypothalamus, Pituitary (GH, ACTH, TSH, FSH, LH, oxytocin and ADH), Adrenal (Aldosterone, Cortisol & Cortisone), Thyroid (T3&T4), Pancreas (Insulin and Glucagon) and Gonads (testosterone, estradiol and progesterone).Hypo and hyper production of hormones.General mechanism of peptide and steroid hormone action.Concept of second messengers.Eg: cAMP, DAG, IP3, G-protein.

B.Sc. VI SEMESTER (SEP)
PHYSIOLOGY AND IMMUNOLOGY
COURSE CODE: DSC-6P SEPBC-603

COURSE TITLE	**PHYSIOLOGY AND IMMUNOLOGY**
COURSE CODE	**DSC-6P SEPBC-603**
COURSE CREDITS	02
TYPE OF THE COURSE	PRACTICAL
TOTAL CONTACT HOURS	64 HOURS (4 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	03
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

1. Estimation of amino acid by Ninhydrin method.
2. Estimation of Cholesterol by Zak's method.
3. Estimation of titrable acidity in urine.
4. Estimation of amino acid by Sorenson's formal titration method.
5. Estimation of Calcium in serum.
6. Estimation of Inorganic phosphorus by Fiske Subbarao method.
7. Estimation of Creatinine by Jaffe's method.
8. Determination of Clotting time and Bleeding time.
9. Blood typing.
10. Determination of % of Haemoglobin.
11. Estimation of Iron by Wong's method.
12. Radial immunodiffusion/ Ouchterlony double diffusion.
13. Determination of RBC and WBC count by Haemocytometer.

ELECTIVE COURSES CAN BE OFFERED AS PER 3RD AND 4TH SEMESTERS WITHOUT REPETITION.

FOR 2026-27 BATCH ONLY
(THIS 2-CREDIT COURSE IS FOR ONLY THE BATCH WHICH WILL BE PROMOTED IN JUNE-AUGUST2026 FROM 4THSEM TO 5THSEM)

B.Sc. VI SEMESTER (SEP)
IMMUNOLOGY
COURSE CODE: DSC-8T SEPBC-602

COURSE TITLE	**IMMUNOLOGY**
COURSE CODE	**DSC-8T SEPBC-602**
COURSE CREDITS	02
TYPE OF THE COURSE	THEORY
TOTAL CONTACT HOURS	32 (2 HOURS/ WEEK)
DURATION OF END SEMESTER ASSESSMENT (ESA) (HOURS)	02
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

Unit I **16Hrs**

Introduction: Cells and Organs of immune system: Primary and secondary lymphoid organs, Bone marrow, Thymus, Spleen.Lymphoid cells, T lymphocytes, types and B lymphocytes, null cells, Mononuclear cells, Macrophages and Granulocytic cells.
Immunity: Innate and adaptive immunity. Innate immunity (non-specific), -Anatomic, physical, phagocytic and inflammatory barriers. Adaptive (specific) immunity: Active and Passive immunity. Formation and functions of T and B lymphocytes (In brief). Humoral and cell mediated immunity. Recognition of antigens by T and B lymphocytes, Processing and presentation of antigens.
Antigens: Types, characteristics, antigenicity, immunogenicity, Immunogens and factors influencing immunogenicity, epitopes, haptens and adjuvants.

Unit II **16 Hrs**
Immunoglobins: Generalised structure of antibody, classes and functions of immunoglobulins. Antigenic determinants of immunoglobulins.Theories of antibody production, clonal expansion theory.Monoclonal antibodies and its production by any one method and applications.Polyclonal antibodies.
T and B lymphocytes: T cell receptors, maturation, activation and differentiation. B-cell receptors, maturation, activation and proliferation.Cytokines- Interferon and Interleukins, importance and functions.
Immunological techniques: Antigen antibody reactions-precipitation and agglutination reactions in immunodiffusion (Ouchterlony and Radial Immunodiffusion), immunoelectrophoresis. ELISA, RIA.
Hypersensitivity reactions: Definition,Types (I, II, III, IV and V), based on time and symptoms.
Vaccines-Types, Active and passive immunization, preparation of vaccines (Rabies vaccine).
Auto immune disorders: Definition,Rheumatoid arthritis, Myasthenia gravis, Parkinson disease

B.Sc. Biochemistry

Panel of Examiners UG 2026

Sl.No.	Names	Address
	Internal Members	
1.	Smt. Premlatha S.J.	Maharani's science College for Women, U.G and P.G. Department of Biochemistry J.L.B. Road, Mysore
2.	Dr. Kumar M.S.	
3.	Smt. Roopa	
4.	Dr. Sharath Chandra S.P.	
5.	Smt. Komala K.P.	
6.	Dr. Jyothsna Karanth	
7.	Dr. Manjunath M.J.	
8.	Dr.Shruthi K.P.	
9.	Smt. Husna Almas	Biochemistry Department of Sharada Vilas College, Mysore
10.	Mr.Likith	
11.	Ms. Ramya	Biochemistry Department, Mahajan First Grade College Mysore
12.	Smt. Radhika	
13.	Dr. Puneeth H.R	Biochemistry Department, MMK & SDM College Mysore
14.	Dr.Wethroe Kapfe	
15.	Dr.J. Rajesh	YCM, Mysore.
16.	Smt. Aysha Firdouse	
17.	Smt. Uma devi	JSS Womens College Saraswathipuram Mysore
18.	Dr. Latha	JSS Ooty Road College, Mysore.
19.	Dr. Chethan	
20.	Dr. Hajeera Banu	
21.	Dr. Shobha N.	Biochemistry Department, Government College For Womens Mandy.
22.	Smt.Sunitha	Biochemistry Department, Government Science College, Hassan.
23.	Mr.Bhargava C.S.	
24.	Smt. Kavitha K.R.	

Chairman
Board of Studies in Biochemistry
University of Mysore
Manasagangotri, Mysore-570 006
INDIA

25.	Smt. Sajeeda Niketh	Biochemistry Department, Government Science College for Nrupathunga Road Banglore
26.	Mr. Rajeev Kolgi	
27.	Mr. Haleshappa	
28.	Dr. Asma Saquib	Biochemistry Department Maharani's science College for Women, Palace Road, Banglore
29.	Smt. Rashmi	
30.	Dr. Keshamma	
31.	Dr. Naganna Gowda	
32.	Dr. Nagesh Babu	
33.	Ms.Anjali	
34.	Dr.Vidya	
35.	Dr.B.L.Nanda	Biochemistry Department, Government First Grade College, Chitradurga
36.	Smt. Suma	
37.	Dr.Bhagyalakshmi	Biochemistry Department, Tumkur University, Tumkur
38.	Dr. Savitha	
39.	Dr. Prabhakar B.T.	Sahyadri Science College, Shimogga

Chairman
Board of Studies in Biochemistry
University of Mysore
Mysore

Department of Studies in Biochemistry
University of Mysore
Manasagangothri, Mysuru

M.Sc. Degree Syllabus
(March 2026)

Department of Studies in Biochemistry

University of Mysore

Manasagangotri, Mysuru

Choice-Based Credit System (2026)

Department of Studies in Biochemistry offers two programmes

1. **M.Sc. Degree in Biochemistry**
2. **Ph.D. Degree in Biochemistry**

M.Sc. Degree in Biochemistry

It is a semester program with four semesters spread over two years.

Programme objectives

The main objectives of the M.Sc. Degree programme are to provide a strong foundation in the subject Biochemistry to take up the following with confidence.

- Teaching faculty position in Academic Institutions.
- Research activities in research institutions or industries.
- Entrepreneurship to start their own company or start-ups.

Programme Learning Outcomes

The M.Sc. degree programme in Biochemistry is a highly sought-after programme in life sciences at the University of Mysore. On successful completion of this programme, each student will:

- Have a strong foundation in understanding the basic biochemical reactions that occur in both prokaryotic and eukaryotic systems. Further, the student will be able to learn cutting-edgetechnologies in cell biology, molecular biology, microbiology, immunology, and medicinal biology, with a focus on current trends in omics biology.
- Develop practical skills along with their theory components, which will help in their research programme both in academic institutions and in R & D programmes of industries.
- Inculcate skills for teaching in academic institutions for undergraduate and postgraduate students.
- Develop confidence in taking competitive examinations in the field of life sciences, both in India and abroad, so that they can pursue higher education.

Pedagogies employed in the M.Sc. Degree programme

- Classroom teaching will be carried outusing a blackboard and chalk, PowerPoint presentation, and information and communications technology.
- One-on-one interaction or with small student numbers during tutorial classes.
- Each student performs experiments as per the protocol in practical classes.
- Student seminar/research paper presentation in each semester.
- Project work on a small research problem during the fourth semester.
- Invited talks from eminent scientists.

Medium of Instruction:English.

Syllabus for M.Sc. Degree in Biochemistry

The Choice-Based Credit System (CBCS) comprises courses in the form of **Hard Cores (HC), Soft Cores (SC)**for Biochemistry students, and **Open Electives (OE)**for other students.The following are the minimum and maximum courses per semester.

The credit pattern is Lecture (L); Tutorial (T); Practical (P); (L:T:P) Pattern.

Lecture:A one-hour classroom lecture of a theory class per week in a semester is considered 01 credit.

Tutorial and Practical:A two-hourinteraction session of tutorial or practical per week in a semester is considered 01 credit.

One semester periodis about 16 weeks of teaching and learning.

The duration of each semesteri Sabout 20 weeks, that included semester classes, final examinations, evaluation work, and breaks.

Credit Pattern of courses:

Hard Cores: 3 – 4 Credits
Soft Cores: 2 – 3 Credits
Open electives: 4 Credits

Credit Distribution of courses:

Course Type	Credits
Hard Core	**Minimum Credits - 42 and Maximum Credits - 52**
Soft Core	**Minimum Credits – 16 and Maximum Credits – 20**
Open elective/ SWAYAM/MOOC	**Minimum Credits – 4**

- A Candidate can enrol for a minimum of 10 Credits per semester and a maximum of 24 Credits per semester, inclusive of Open Elective earned from the other Departments as per UGC regulations. SWAYAM/MOOC courses are extra.
- A candidate must earn a minimum of 76 Credits for the successful completion of the M. Sc. Degree in Biochemistry, including a minimum of 04 credits earned from open electives, SWAYAM/MOOC.
- The total number of 76 credits earned must include the minimum distribution pattern, HC-52 credits, SC-20 credits, and OE- 04 credits.

Continuous Assessment Pattern for each course (70:30) pattern:

Continuous Assessment	Time Duration in each semester	Marks		C1+C2 minimum 30% to be eligible for C3. Final aggregate,C1+C2+C3 minimum 40% to declare pass in a semester
		Max	Min	
C1	1st week to 8th week	15	4.5	
C2	9th week to 16th week	15	4.5	
C3	After 16th week (Written Examination)	70	21	

C1 and C2 involve tests, assignments, viva-voce, and seminars.

C3 involves afinal written examination at the end of the semester.

Minimum Credit Distribution of courses

Hard Core- 52 Credits

Soft Core- 20 Credits

Open Elective-04 credits

Semester	Hard Core	Soft Core	OE/SWAYAM/ MOOC	Total Credits
I	4 + 3 + 3 + 3 (13)	3 + 3 + 3 (6)	0	19 + 0
II	4 + 3 +3+ 3 +3 (16)	3 + 3 +3 (6)	0	22 + 0
III	4 + 3+ 3 + 3 (13)	3 + 2 +2 (5)	4	18 + 4
IV	4 + 3+ 3 (10)	3 (Project)+ 3 (3)	0	13 + 0
Total	**52**	**20**	**4**	**72 + 04 = 76**

Eligibility for admission:

Students with a **Bachelor of Science degree with Biochemistry/Chemistry/any Life Science subjects recognized by the UGC.** Students from Foreign Countries will apply through the Equivalence Committee of the University of Mysore. Minimum percentage of marks is as prescribed by the University of Mysore regulations for admission.

I Semester

Sl. No.	Paper Code	Title of the course	Course Type	Credit pattern			Total Credits	Exam duration in hr
				L	T	P		
1		Chemistry of Biomolecules	HC	3	0	0	3	3
2		Bioorganic and Bioinorganic Chemistry	HC	3	0	0	3	3
3		Biochemical and Biophysical Techniques	HC	3	0	0	3	3
4		Practical-1: Biochemical Techniques and Estimations	HC	0	0	4	4	6
5		Physiology and Nutritional Biochemistry	SC	3	0	0	3	3
6		Plant Biochemistry	SC	3	0	0	3	3
7		Microbial Biochemistry and Toxicology	SC	3	0	0	3	3

II Semester

Sl. No.	Paper Code	Title of the course	Course Type	Credit pattern			Total Credits	Exam duration in hr.
				L	T	P		
1		Enzymology	HC	3	0	0	3	3
2		Metabolism and energetics of carbohydrates and lipids	HC	3	0	0	3	3
3		Metabolism of amino acids, proteins, and nucleic acids.	HC	3	0	0	3	3
4		Membrane Biology	HC	3	0	0	3	3
5		Practical- 2: Experiments in Enzymology and Membrane Biology.	HC	0	0	4	4	6
6		Hormones and Cell Signalling	SC	3	0	0	3	3
7		Biostatistics	SC	3	0	0	3	3
8		Genomics and proteomics	SC	3	0	0	3	3

III Semester

Sl. No	Paper Code	Title of the course	Course Type	Credit pattern			Total Credits	Exam duration in hr
				L	T	P		
1		Genome organization and its replication	HC	3	0	0	3	3
2		Transcription, translation, and regulation	HC	3	0	0	3	3
3		Clinical Biochemistry	HC	3	0	0	3	3
4		Practical-3: Experiments in molecular biology and clinical biochemistry	HC	0	0	4	4	6
5		Genetic Engineering	SC	2	0	0	2	2
6		Plant Biotechnology	SC	2	0	0	2	2
7		Animal Biotechnology	SC	2	0	0	2	2
8		Fundamentals of Biochemistry	OE	4	0	0	4	3

IV Semester

Sl. No.	Paper Code	Title of the course	Course Type	Credit pattern			Total Credits	Exam duration in hr
				L	T	P		
1		Immunology	HC	3	0	0	3	3
2		Cell Biology and genetics	HC	3	0	0	3	3
2		Practical-4: Experiments in immunology and genetic engineering.	HC	0	0	4	4	6
3		Project Work	SC	0	0	3	3	3
4		Bioprocessing, Biosafety, and Ethics	SC	3	0	0	3	3
5		Diagnosis in health and disease	OE	4	0	0	4	3

Course Design:Hard-corepapers are either 3 or 4 credits,and soft-core papers are either 2 or 3 credits. The open elective paper is for 4 credits. Each course is divided into four units. Courses with 3 or 4 credits, each unit carries 12 hours of lecturing, and in courses with 2-credits, each unit carries 8 hours of lecturing.

I Semester Biochemistry

Courses - Hard Cores

Chemistry of Biomolecules– 3 credits 48h

Objectives are:

- To study various biomolecules of a cell.
- To study the structural characterization of biomolecules.

Course outcome: The student will:

- Understand the basic structure and classification of carbohydrates, amino acids, lipids, proteins, and nucleic acids.
- Understand the structure-function of glycobiology, protein folding, and forces affecting protein folding.
- Understand the structure-function of lipids in membranes and the sequencing of DNA.

Unit- 1

Carbohydrates:Structure and classification, monosaccharides, disaccharides and polysaccharides.

Pentoses, hexoses, deoxysugars, amino sugars, muramic acid, neuraminic acid. Linkages in sucrose, lactose, maltose, trehalose, and glycosides.

Homopolysaccharides and heteropolysaccharides - starch, cellulose, glycogen, hyaluronic acid, chondroitin sulphate, chitin, xylans, bacterial cell wall polysaccharides, blood group polysaccharides.

Structure elucidation of polysaccharides - degradation, graded acid hydrolysis, periodate oxidation, degradation of exopolysaccharides, methylation, acetylation.

Glycoproteins - Glycosidic bonds, N- and O-glycosylation, lectins, carbohydrates in tissue engineering. Proteoglycans:aggrecan, syndecan, and decorin. Pectin and pectic polysaccharides.

Unit-2

Amino acids and Proteins:Nomenclature and classification of amino acids.Zwitterionic structure and buffering properties. Reaction of amino acids. Unusual and non-protein amino acids.

Features of the peptide bond. Naturally occurring peptides; glutathione, enkaphalins and endorphins. Chemical synthesis of peptides; solution phase synthesis, Merrifield's solid phase synthesis, and peptide ligation.

Structure of proteins –Determination of amino acid compositions and primary structure, acid and base catalyzed hydrolysis, separation, quantification, determination

of N and C terminal residues.Determination of glycosylation site and type of linkage (o-glycosyl and n-glycosyl). Determination of s-s-bond position. Sequencing strategies; sequencing methods. Automated sequencers.

Unit-3.
Secondary structure of proteins:alpha helix**,** β-sheet, β-bend, β-turn, and super secondary structures. Secondary structure prediction and Ramachandran plot.
Tertiary and quaternary structures of proteins: Forces of interaction; hydrogen bonding, Vander Waal's forces, London force, ionic interactions, hydrophobic interactions, S-S bridges.
3D Structure of myoglobin,hemoglobin, immunoglobulin, collagen, chymotrypsin,and keratin.
Protein folding:Denaturation and renaturation of proteins; Anfinsen's experiment. Molten globule, Levinthal paradox. Role of Chaperons in protein folding.
Introduction to protein modification:Glycosidic, phosphate, acetylation, methylation, hydroxylation, and prenylation.
Overview of purification and criteria to establish protein purity.

Unit- 4
Lipids: Occurrence and classification of lipids; oils, fats, and waxes. Properties of fatty acids, esters of fatty acids, cholesterol, phospholipids, glycolipids, sphingolipids, cerebrosides, and gangliosides.
Nucleic Acids:Structure of nucleosides and nucleotides. Structure of DNA**:**Watson and Crick model; Chargaff's rule, B and Z DNA, other models of DNA structure. Secondary structural features in DNA.
DNA protein interaction:zinc finger, leucine zipper, helix-turn-helix, other motifs, DNA bending, and kinks.
Physiochemical properties of DNA:melting of DNA, Tm; factors affecting Tm, Structure of RNA**:** Types, structure, and physicochemical properties of RNA.Chemical reactions of RNA. Secondary structure of tRNA; cloverleaf model.Stem loop structure, palindromic sequences, and cruciforms.
References:
Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G (All Editions).
Molecular Cell Biology by Lodish and others (All Editions)

Bioorganic and Bioinorganic Chemistry - 3 Credits 48 h

Objectives are:
- To understand the basics of chemistry to study the chemistry of biomolecules.
- To study organic reactions to understand biochemical reaction mechanisms.

Course outcome: the student will:
- Understand the logic in understanding biomolecular interactions.
- Understand the stereochemistry of biomolecules and heterocyclic compounds.

- Understand the role of electrolytes in biological systems.

Unit-1:
Bonding:Non-covalent bonds/interactions, hydrogen bond, ionic, electrostatic, Van der Waals forces, hydrophobic interactions. Covalent bonds; coordinate bond; coordinate bond formation in transition metals. Bonding of iron in hemoglobin and cytochromes, cobalt in Vitamin B_{12}, and magnesium in chlorophyll. Crystal field theory, Ligand field theory, and Valence bond theory. Chelators: types of ligands and complexes. Special properties of water:structure and bonding.

Unit-2:
Stereochemistry:Concept of isomerism, and isomers,position and order of groups around carbon. Optical and geometric isomerism; absolute and relative configuration. Symmetry view of chirality, relation between chirality and optical activity, representation of chiral structures by Fischer, and significance of mutarotation. Structure and stereochemistry of sugars and amino acids; anomers, epimers, diastereomers, stereoisomers, D and L, (+) and (-), R and S. Importance of stereochemistry. Stereochemistry of sucrose, maltose, and trehalose.

Unit-3:
Mechanism of organic reactions:Classification and types of organic reactions, Reaction intermediates, molecularity, and order of a reaction. Reaction energetics. Mechanisms and stereochemistry of substitution (electrophilic and nucleophilic - SN1 and SN2 reactions), addition, elimination, and rearrangement reactions. Mechanisms of ester hydrolysis. Property of aromaticity and resonance.

Unit-4:
Electrolytes, Non-Electrolytes and Electrodes: Osmotic pressure, vapor pressure, osmometer, Donnan membrane equilibrium. Hydrogen electrode, electrode potential, and redox potential.
Heterocyclic Compounds: Chemistry of pyrrole, furan, thiophene, indole, thiazole, pterine, pteridine, and isoalloxazine. Chemistry of porphyrins and heme and their biological importance.
References:
Advanced Organic Chemistry by Arun Bahl and B S Bahl (All Editions).
Organic Chemistry by Henreikson (All Editions).
Advanced Chemistry by Mathews.
Principles of Inorganic Chemistry by Puri and others.
Organic Chemistry by S. Ege.

Biochemical and Biophysical Techniques -3 Credits 48 h

Objectives are:
- To study various techniques and their principles involvedin biochemical analysis.
- To get an exposure to advanced techniques of Biochemistry

Course outcome: The student will:

- Understand various animal models used in biology.
- Understand the application of the basic and advanced techniques in their future academic activities.
- Understand separation and characterization of biomolecules using different chromatographic methods, electrophoretic methods, and blotting techniques.

Unit-1:

Cell fractionation techniques: Cell lysis, homogenization, extraction, salting in, salting out, dialysis, and ultrafiltration.

Chromatographic techniques: Principles and applications of paper, TLC, adsorption, gel filtration. Ion exchange, chromatofocusing, affinity, HPLC,RP-HPLC, FPLC. GLC,MS - Electrospray Ionization, fragmentation, m/e, time of flight, MALDI, LC-MS, and LC-MS-MS. Centrifugation: Svedberg's constant, sedimentation velocity, and sedimentation equilibrium.Types ofcentrifugations: Differential, density gradient,and analytical ultracentrifugation – optical systems.

Unit-2:

Electrophoretic techniques: Polyacrylamide gel electrophoresis, preparation, and composition of a gel. SDS-PAGE, gradient gel.

2D-electrophoresis, agarose gel electrophoresis, isoelectric focusing, and capillary electrophoresis.Visualizing proteins, glycoproteins, lipoproteins, and nucleic acids. Zymogram and reverse zymogram.

Unit-3:

Spectroscopic techniques: Principles of colorimeter, spectrophotometer, fluorimeter,instrumentation, and applications. Beer-Lambert's Law, and its limitations. Extinction coefficient, fluorescent probes, and their applications. Turbidometry, flame photometry, atomic absorption, and spectrophotometry. Nuclear Magnetic Resonance: NMR, ESR, and principles and applications. Vibration Spectra: IR and Raman; principles and applications.Light Scattering: ORD and CD.

Unit-4:

X-ray Crystallography:Protein crystals, Bragg's law, unit cell, isomorphous replacement, fiber pattern of DNA.

Isotopes: Heavy isotopes and radio isotopes, theory and construction of a mass spectrometer.

Radioisotopes in Biology**:** ^{3}H, ^{14}C, ^{32}P, ^{131}I, ^{35}S, concept of half-life, decay constant, detection and quantitation - GM counter and solid and liquid scintillation counter. Specific activity, autoradiography, and its applications.

References:

Practical Biochemistry, Principles and Techniques by Keith Wilson and John Walker (All Editions).

Biophysical Chemistry, Principles and Techniques by Avinash Upadyaya and others.

Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).

Biochemistry by Lubert Stryer (All Editions).

Textbook of Biochemistry by Devlin (All Editions).

Biochemistry by Voet D, Voet JG (All Editions).

Biochemistry by Zuby G (All Editions).

Molecular Cell Biology by Lodish and others (All Editions)

Practical - 1: Biochemical techniques and estimations- 4 Credits 8 h/week

Objectives are:

- To develop skills in the practical components and to learn good laboratory practices
- To learn the preparations of various solutions.
- To learn various estimations of biomolecules using different methods.

Course outcome: the student will:

- Understand the basics of solutions and their preparations with respect to percent solution, molar, and normal solutions.
- Understand separation and analysis of various biomolecules using chromatographic, colorimetric, and titration methods.

Colorimetry**;** applications of Beer-Lambert's law, determination of extinction coefficient,
Carbohydrates: Isolation of polysaccharides, estimation of sugar by DNS and anthrone methods.
Amino acids and proteins:Separation of amino acids by ascending, descending, and circular paper chromatography.
Estimation of protein by the Biuret method and Lowry's method.
Lipids:Extraction of neutral lipids, phospholipids, and estimation of phospholipids. TLC of lipids. Titrimetric estimations. Iodine number, saponification value, acid value, and peroxide value.
Reference:
Manual of Practical Biochemistry by Rafi MD.
Biochemical Calculations by Irwin H Segel.
A Manual of Laboratory Techniques (NIN) by N. Raghuramulu and others.

Courses: Soft Cores

Physiology and Nutritional Biochemistry- 3 Credits 48 h

Objectives are:

- To study different systems operating in living organisms.
- To study the nutritional requirements of our body.

Course outcome: the student will:

- Understand various systems and their physiological functions.
- Understand how the systems functionally integrate each other.
- Understand blood and its composition, nervous, respiratory, excretory, digestive, and muscle physiology.
- Understand the role and requirement of micro and macronutrients in various individuals.

Unit-1:
Blood:Composition, cells, plasma proteins, lipoproteins and their functions, HDL, LDL, VLDL, chylomicrons. Different blood cells - Erythrocytes: shape and function.

WBCs:types, differential count, and functions. Platelets and their function. Half-life of blood cells. Buffer systems. Preparation of plasma and serum. Hemostasis, blood clotting, different pathways of blood clotting, and clot hydrolysis.
Respiratory System: Lungs, structure and functions, gas exchange, oxygen binding by hemoglobin and myoglobin, factors affecting oxygenation and acid-base balance.

Unit-2
Nervous system: Parts of the brain, CSF; composition and function. Structure of a neuron.
Digestive System: GI tract, digestion, and absorption of carbohydrates, proteins, and lipids. Mechanism of HCI production in the stomach.
Excretory System: Ultrastructure of the nephron, glomerular filtration, filtration rate, mechanism of formation of urine, acid-base balance. Water metabolism: distribution in the body, water balance, and factors affecting water balance.
Hepatobiliary System: Anatomy of the liver, blood supply, cells; hepatocytes, endothelial cells, and Kupffer cells, secretory and excretory functions, and formation of bile. Role of the liver in detoxification.
Muscle physiology: Types of muscle, structure of skeletal muscle and smooth muscle, muscle proteins; actin, myosin, tropomyosin, troponins.

Unit-3
Nutrition:Concepts of macro and micronutrients, essential nutrients, and their classification. Food groups, proximate analysis of foods, chemical and biological analysis for nutrients. Food as a source of energy, methods of determining energy value of foods, calorimetry, physiological fuel value, daily requirement of energy, high and low-calorie diets. Basal metabolic rate (BMR), factors affecting BMR, specific dynamic action of foods. Probiotics and prebiotics.

Unit-4
Carbohydrates: Dietary sources, dietary fiber, and essentiality of carbohydrates. Carbohydrate storage. Proteins: Essential amino acids, evaluation of nutritive value of dietary proteins, PER, BV, nutritional classification of proteins, supplementary value of proteins.Protein-calorie malnutrition:Kwashiorkar and Marasmus. Fats: Dietary value of fats and lipids,Sources, invisible fat, essential fatty acids, PUFA. W-3, w-6 fatty acids, DHA, EPA.
Vitamins: Fat-soluble and water-soluble vitamins, provitamins, antivitamins, dietary sources, daily requirements, structure, and function. Deficiency symptoms of water-soluble and fat-soluble vitamins, hypervitaminosis, and vitamin-like compounds.
Minerals:Macro and micronutrients, sources, requirements, functions, and deficiency symptoms.

References:
Textbook of Human Nutrition by Mahtab S Bamji and others.
Textbook of Clinical Nutrition and Functional Medicine by Alex Vasquez.Handbook of Food and Nutrition by Swaminathan
Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Struyer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Voet D, Voet JG Biochemistry (All Editions).
Zuby G Biochemistry (All Editions).

Plant Biochemistry - 3 Credits 48 h

Objectives are:

- To study major biochemical reactions in the plant system.
- To study secondary metabolites and their role in host-parasite interaction.

Course outcome: the student will:

- Understand the harvesting of solar energy to chemical energy by photosynthesis, solute transport, and photo assimilate translocation process
- Understand nitrogen metabolism and various plant hormones in different stages of plant development.
- Understand various phytochemicals as secondary metabolites and their role in the plant defense system.

Unit-1:

Photosynthesis: Photosynthetic apparatus in plants, photosystems I and II, light-harvesting antenna complex. Electron flow and photophosphorylation; cyclic and noncyclic, oxygen evolution, Calvin cycle. C3, C4, and CAM cycle. Photorespiration. Regulation of photosynthesis. RUBISCO.

Nitrogen metabolism:Importance of nitrogen in biological systems. Nitrogen cycle; Nitrogen fixation, symbiotic and non-symbiotic, nitrogenase complex, energetics and regulation. Formation of root nodules in legumes.Assimilation of nitrate and ammonium ions.

Unit-2:

Plant hormones:Biosynthesis, storage, breakdown, and transport. Physiological effects and mechanisms of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, and jasmonic acid.

Sensory photobiology: Mechanism of stomatal movement, photoperiodism and biological clocks. Seed dormancy, inception of germination. Germination and growth regulators, vernalization.

Unit-3:

Solute transport and photo assimilate translocation:Uptake, transport, and translocation of water, ions, solutes, and macromolecules from soil through xylem and phloem. Transpiration, mechanisms of loading and unloading of photoassimilates.

Phytochemicals:Secondary metabolites**;** terpenes, phenols, flavonoids, and nitrogenous compounds, and their roles in plant physiology and as alternative medicine.

Extraction, fractionation, and characterization of phytochemicals.

Unit-4:

Stress physiology:Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature, and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress.

Host parasite interaction:Recognition and entry processes of different pathogens like agarobacterium, Tobacco mosaic virus,and virus-induced cell transformation. Cell-cell fusion in both normal and abnormal cells. Plant defence system.

References:

Plant biochemistry by Dey PM, Harborne JB. Academic Press (All Editions).

Introduction to plant biochemistry by Goodwin TW, Mercer EI. (All Editions).

Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G (All Editions).

Microbial Biochemistry and Toxicology- 3 Credits, 48 h

Objectives are:

- To study how microbes are an essential part of our environment.
- To study the beneficial and harmful effects of microbes.
- To study the impact of toxicants on living organisms.

Course outcome: the student will:

- Understand the significance of microorganisms in human life.
- Understand how microorganisms may be identified and characterized.
- Understand how toxicants will affect our physiology as well as the environment.

Unit-1:

Historical Aspects: Discovery of microorganisms- Hook, Antony van Leeuwenhoek; Contribution of Pasteur and Koch.
General characteristics**:** morphology, nomenclature, and classification of viruses, bacteria, fungi, actinomycetes, rickettesiae.
Microscopy: Simple, compound, phase contrast, fluorescence, and electron microscopy.
Techniques:Isolation and culture of bacteria - aerobic and anaerobic culture methods, culture media. Isolation of a pure colony, characterization. Staining – Gram's, acid-fast, endospore, flagella.

Unit- 2:

Bacterial growth: Nutrient requirements, culture media, and classification of media. Generation time, growth curve, synchronous growth, continuous culture, and factors affecting growth. Methods for measurement of microbial growth.
Bacterial photosynthesis: Different types of photosynthetic bacteria, photopigments, paths of carbon and electrons in bacterial photosynthesis.
Microbial Signalling: Quorum sensing, biofilms, response to anti-microbials, sporulation-inducing signals and events in sporulation.

Unit- 3:

Definition and Scope of Toxicology:Types of toxins-chemical, biological, and environmental, dose-response relationship, synergism and antagonism, determination of ED50 & LD50, acute and chronic exposure.
Xenobiotic metabolism: absorption & distribution, phase I reactions; oxidation, reduction, hydrolysis and hydration; phase II reactions/conjugation; glucouronidation, sulfation, Acetylation, methylation, glutathione and amino acid conjugations, detoxification.

Unit- 4:
Biochemical basis of toxicity: Chemical nature of toxicants; biochemical and genetic mechanism of toxicity, biochemistry of mutagens and carcinogens.
Pesticide toxicity: Insecticides and their classification. Metal &Metalloid toxicity: toxicity of arsenic, mercury, lead, chromium, and cadmium
Natural toxins – Mycotoxins,plant and animal toxins.
Toxic organic Compounds: toxicity of alkanes; unsaturated non-aromatic compounds. Toxicity of benzene, naphthalene, formaldehyde, and alcohols.

References:

Microbiology by Prescott (All Editions)
Clinical Microbiology Made Ridiculously Simple by Mark T. Gladwin and others (All Editions)
Microbiology with Diseases by Taxonomy by Robert Bauman(All Editions).
A Textbook of Modern Toxicology by Ernest Hodgson (All Editions).
Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G (All Editions).

II Semester Biochemistry

Courses - Hard Cores

Enzymology - 3 Credits 48 h

Objectives are:

- To study general aspects of enzymes and their classification.
- To study the mechanisms of enzyme reactions using inhibitors and activators

Course outcome: the student will:

- Understand enzymes, their activity measurements, and the kinetics of reactions.
- Understand enzyme reactions using inhibitors and activators to understand the nature of catalysis, the mechanism of action, and the type of inhibition.
- Understand the regulation of enzymes in metabolic reactions.

Unit-1:
General aspects: Nature of enzymes, localization, isolation, purification, and characterization of enzymes. Marker enzymes, criteria of purity of enzymes, and fold purity. Nomenclature and IUB classification of enzymes. Enzyme specificity, specific activity, assay methods; coupled enzyme assays, continuous, endpoint, and kinetic assay. Units of enzyme activity, specific activity, Km, Vmax, turnover number, and Katal. Activation energy, free energy change, and binding energy.

Unit-2:

Enzyme kinetics: Michaelis-Menten equation for uni-substrate reactions, initial velocityapproach, steady state approach. Vmax, Km and their significance. Linear transformation of Michaelis-Menten equation; Lineweaver-Burk plot, Eadie-Hofstee, Wolf and Cornish-Bowden, and Scatchard plots.

Rate of a reaction, order, and molecularity. I order reaction kinetics. Rectangular hyperbola, Michaelis-Menten equation as rectangular hyperbola, linear transformation, calculation, and significance of slope, intercept, and asymptote.

Inhibition: Reversible and irreversible inhibition; competitive, non-competitive, uncompetitive, product inhibition, and suicide inhibition. Feedback inhibition, feed-forward inhibition. Determination of Ki and Kd.

Unit-3:

Bisubstrate reactions: Cleland's notation with examples, ordered, ping-pong, and random reactions.

Cooperativity: Binding of ligands to macromolecules; Scatchard plot, positive and negative cooperativity. Oxygen binding to hemoglobin. Hill equation, homotropic and heterotropiceffectors, aspartyltranscarbamylase as an allosteric enzyme.

Mechanisms of enzyme catalysis: Active site structure; methods of determining active site structure. Isolation of ES complex, affinity labeling, chemical modification studies, site directed mutagenesis.

Nature of enzyme catalysis: Transition state theory, proximity and orientation, orbital steering, acid-base catalysis, covalent catalysis, metal ion catalysis, nucleophilic and electrophilic catalysis, intramolecular catalysis, entropy effects. Effect of temperature and pH on enzyme-catalysed reaction.

Unit-4:

Mechanisms of action of specific enzyme: Chymotrypsin; zymogen activation, acid-base catalysis, charge relay network. Lysozyme, alcohol dehydrogenase, ribonuclease, carboxypeptidase A, RNA as an enzyme, and abzymes.

Coenzyme action of NAD^+, FAD, TPP, PLP, Biotin, CoA, folic acid, and lipoic acid.

Isoenzymes: LDH, multifunctional enzymes (DNA polymerase), and multi-enzyme complex (PDC).

Metabolic regulation of enzyme activity: Feedback regulation and fine control. Fast reactions: stopped-flow and temperature-jump methods, with examples of enzymes.

References:

Enzyme Structure and Mechanism by Allen Ferhst.

Enzymes: Catalysis, Kinetics, and Mechanismsby N.S. Punekar.

Fundamentals of Enzymology. Biochemistry and Molecular Biology Education by Price NC and Frey PA.

Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by Palmer T, Bonner PL.

Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).

Biochemistry by Lubert Stryer (All Editions).

Textbook of Biochemistry by Devlin (All Editions).

Biochemistry by Voet D, Voet JG (All Editions).

Biochemistry by Zuby G (All Editions).

Metabolism and Energetics of Carbohydrates and Lipids- 3 Credits 48 h

Objectives are:

- To study different aspects of catabolism, anabolism, and amphibolic pathways of carbohydrate and lipid metabolism
- To study the synthesis of high-energy compounds, energy utilization, and disorders of carbohydrate metabolism.
- To study lipid synthesis and its degradation.
- To study Lipid metabolism, intermediate metabolism, and its regulation.

Course outcome: the student will:

- Understand the degradation of carbohydrates via glycolysis, citric acid cycle, and their regulations, including hormonal regulation during the synthesis of high-energy compounds and their utilization.
- Understand biosynthesis of sucrose, lactose, starch, and glycogen.
- Understand biosynthesis and degradation of lipids in relation to energy production and energy conservation.
- Understand the role of cholesterol and other lipids in normal and diseased conditions.
- Understand the general lipid metabolism and intermediate metabolism in the energy storage mechanism.

Unit-1:

Introduction - Catabolism, anabolism, and amphibolic pathways.

Carbohydrates: Cellular ingestion of glucose, glycolysis, energetics regulation. Pathways of utilization of pyruvate-lactate, ethanol, gluconeogenesis, regulation, Cori cycle, glucose paradox, citric acid cycle, its regulation, energetics, anaplerosis, glyoxylate cycle. HMP shunt pathway, interconversion of hexoses. Utilization of non-glucose sugars. Biosynthesis of sucrose, lactose, starch, and glycogen.

Hormonal regulation of glycogen metabolism: Effect of hormones on carbohydrate metabolism; insulin, glucagon, catecholamines, growth hormones, corticosteroids, and thyroid hormones in different tissues. Secretion of Insulin and glucagon in response to various stimuli (Fasting, food, intestinal hormones). Disorders of carbohydrate metabolism: diabetes mellitus.

Unit-2:

Energy Utilization: I, II, and III laws of thermodynamics. enthalpy, entropy, free energy. High energy compounds,**e**nergycurrency, ATP, ADP, creatine phosphate, phosphoenol pyruvate, as energy rich compounds.

ATP synthesis, ATP synthase complex, binding change mechanism, proton motive force, Mitchell's hypothesis. Substrate-level phosphorylation, futile cycles, and their application.

Mitochondrial electron transport: Entry of reducing equivalents for oxidation; malate-aspartate shuttle, glycerol phosphate shuttle. Organization of respiratory chain complexes, structure and function of the components; Fe-S proteins, cytochromes, Q cycle, proton transfer, P/O ratio, respiratory control, oxidative phosphorylation, uncouplers and inhibitors, sequence of electron carriers based on red-ox potentials.

Unit-3:
Lipids: Degradation of triacylglycerols, phospholipids, and sphingolipids and regulations; lipase, hormone-sensitive lipase, phospholipases, and sphingomyelinase. Fatty acid degradation β-oxidation, Knoop's experiment, saturated and unsaturated fatty acids. α and ω oxidation,Regulatory aspects.
Energetics and biosynthesis of fatty acids; fatty acid synthetase complex, chain elongation, and desaturation. Pathways in plants and animals, conversion of linoleate to arachidonic acid.
Lipid mediators: An introduction to Eicosanoids, prostaglandins, leukotrienes, prostacyclins, thromboxanes, DAG, ceramide, and PAF.

Unit-4:
Cholesterol synthesis, degradation, and regulations, cholesterol-lowering drugs: Metabolism of circulating lipids; chylomicrons, HDL, LDL, and VLDL. Reverse cholesterol transport by HDL. Oxidized lipids, foam cell formation.
Phospholipid biosynthesis and regulations: De novo pathway and interconversion, biosynthesis of phospholipids, sphingolipids, ether lipids, and glycolipids. Degradation and biosynthesis of gangliosides and cerebrosides.
Integration of metabolic pathways: Integration of carbohydrate and lipid metabolism, and their regulation and manipulation.
References:
Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G (All Editions).
Molecular Cell Biology by Lodish and others (All Editions).
Molecular Biology of the Cell by Alberts and others (All Editions).

Metabolism of Amino acids, Proteins, and Nucleic acids- 3 Credits 48 h

Objectives are:
- To study the metabolism of Proteins
- To study nitrogen metabolism and photosynthesis.
- To study the metabolism of nucleic acids.

Course outcome: the student will:
- Understand the biosynthesis and degradation of amino acids
- Understand the detailed synthesis and degradation of purine and pyrimidine pathways and their disorders.

Unit – 1:
Proteins: General mechanisms of degradation in cells; ubiquitin-proteosome pathway, lysosomal pathway. Degradation and biosynthesis of glycoproteins and proteoglycans.

Degradation and biosynthesis of heme. Non-ribosomal peptide synthesis: glutathione, gramicidine. Biosynthesis of physiologically active amines: serotonin, histamine, dopamine, norepinephrine, and epinephrine.

Unit – 2:
General mechanisms of amino acid metabolism and regulations: Role of cofactors; PLP, FMN, and THF in amino acid metabolism. Deamination, transamination, decarboxylation, anddesulphurationprocesses. Urea cycle.

Unit – 3:
Metabolic breakdown of individual amino acids. Biosynthesis of non-essential amino acids in humans and synthesis of essential amino acids in plants.
Regulation of amino acid biosynthesis; transglutaminase cycle.
Inborn errors of amino acid metabolism - Phenylketonuria, Alkaptonuria, Maple syrup urine.

Unit – 4:
Purines and pyrimidines: Pathways of biosynthesis and degradation of nucleic acids, purines and pyrimidines, and uric acid formation. Salvage pathways, de novo biosynthetic pathways, and regulations.
Conversion of nucleotides to deoxynucleotides. Gout and Lysch-Nyhan syndrome: Mechanisms of action of methotrexate, 5-fluorouridine, azathymidine.
Biosynthesis of cofactors: NAD^+, FAD, and coenzyme A, polyamine biosynthesis, and their metabolic role.

References:
Lehninger Principles of Biochemistry by Nelson and Cox (AllEditions).
Biochemistry by Lubert Stryer (AllEditions).
Textbook of Biochemistry by Devlin (AllEditions).
Biochemistry by Voet D, Voet JG (AllEditions).
Biochemistry by Zuby G (AllEditions).
Molecular Cell Biology by Lodish and others (All Editions).
Molecular Biology of the Cell by Alberts and others (All Editions).

Membrane Biology - 3 Credits 48 h

Objectives are:
- To study biological membrane structure and function.
- To study the physiological processes of biological membranes

Course outcome: the student will:
- Understand properties of biological membranes and different models of membranes, explaining the biological function.
- Understand membrane asymmetry and other properties using various methods.
- Understand the complex mechanism involved in the transportation of biomolecules across membranes.

Unit-1:
Physico-chemical properties of membranes: Compositions and supramolecular organization. Membrane lipid phases: bilayer phase, non-bilayer phase, phase transition, and membrane potential.
Models of membrane: Evolution in the concept of membrane models, Gorter and Grendel's experiment. Bilayer structure; Danielle - Davson model of membrane, Singer and Nicholson's model.
Membrane asymmetry; Membrane lipids, proteins, and carbohydrates and their lateral diffusion. Biogenesis of lipids and proteins, polarized cells, membrane domains; caveolae, rafts, and protein turnover. Biogenesis of subcellular organelles.

Unit-2:
Methods of study of membrane structure: Lipid transfer proteins, phospholipases, chemical methods, amino-phospholipid translocation, TNBS reagent, freeze fracture, and freeze etching. Lipid vesicles; liposome preparations and application, function of sterols in membranes. FRET, FRAP, Cell fusion, and shedding of membrane.

Unit-3:
Membrane transport:Laws of diffusion across membranes; simple diffusion, facilitated diffusion, and active transport. Glucose transporters, Ca^{2+} ATPase, Na^{+}-K^{+}ATPase (Structure and mechanism of action). Endocytosis, receptor-mediated endocytosis, exocytosis, ion channels; gated and non-gated, aquaporin channel.Bacterial phosphotransferase system.

Unit-4:
Nerve transmission:Structure and types of Neurons. Acetylcholine receptor and neurotransmitters, mechanisms of nerve conduction, resting and action potential, ion channels, ionophores, and the patch-clamp technique. Presynaptic and postsynaptic membranes. Nicotinic and muscarinic neurons. GABA, NMDA, structure and function. Muscle contraction: Role of calcium, calmodulin, and phospholamban. Mechanisms of skeletal and smooth muscle contraction:the sliding filament model.

References:

Lehninger Principles of Biochemistry by Nelson and Cox (AllEditions).
Biochemistry by Lubert Stryer (AllEditions).
Textbook of Biochemistry by Devlin (AllEditions).
Biochemistry by Voet D, Voet JG (AllEditions).
Biochemistry by Zuby G (AllEditions).
Molecular Biology of the Cell by Alberts and others (All Editions).

Practical - 2:

Experiments in Enzymology and Membrane Biology-
4 Credits 8 h/week

Objectives are:

- To develop skills in the practical components and to learn good laboratory practices
- To learn colorimetric estimation of biomolecules.
- To learn enzyme assays.

Course outcome: the student will:

- Understand the estimation of proteins by different colorimetric methods.
- Understand different enzyme assays with respect to specific activity, Km, Vmax, and the effect of pH, temperature, and substrates.

Enzymes: Salivary Amylase, Protease, and Invertase from latex, Esterase from Pea and alkaline phosphatase from milk.
Specific activity, pHand temperature optimum, energy of activation, Km, Vmax Ki. Ammonium sulphate fractionation of esterase from Pea.
Hemolytic activity, Ghost membrane preparation. Micelles and vesicles preparation from egg phospholipids.

References:

Methods in Enzymology, Volumes.

Courses: Soft cores

Hormones and Cell Signalling - 3 Credits 48 h

Objectives are:

- To study the endocrine system
- To study the crosstalk between cells.

Course outcome: the student will:

- Understand various endocrine functions
- Understand various communication systems.
- Understand how signal transduction operates.

Unit -1:

Endocrine System: Endocrine organs in man. Location and interrelationship of endocrine glands in man; classification and chemistry of hormones, hormones of hypothalamus, pituitary, thyroid, parathyroid, pancreas, liver, adrenals, gonads, and intestine, and stomach.
Functions and abnormalities: Hypo and hyper production of hormones secreted by the pituitary, thyroid, pancreas, adrenals, and gonads.

Unit-2:

Structure and control of hypothalamus function: Hormones produced; GRH, somatostatin, TRH, CRH, GnRH.
Pituitary gland:Structure, hormones of anterior, posterior, and median lobes. Pro-opiomelanocortin.
Testes and ovaries: Structure, hormones produced by testes and ovaries, menstrual cycle.

Regulation of hormone production and release: hypothalamus-pituitary-target organ axis and regulation by feedback mechanism.

Unit-3:

Mechanism of hormone action: Peptide hormones,general mechanisms of cell signaling by hydrophilic factors, metabotropic receptors, transmembrane receptors, G protein-coupled receptors, receptor tyrosine kinase, eicosanoid receptors, ionotropic receptors,Second messenger concept.

Second messengers: IP_3, DAG, cAMP, protein kinases, various pathways, JAK-STAT, MAPK, PI3 kinase. Gaseous messengers signalling, nitric oxide, carbon monoxide, and hydrogen sulfide, generation and action.

Growth factors: Structure, mechanism of action, and receptors of EGF, PDGF, NGF, IGF, and insulin receptor.

Unit-4:

Mechanism of action of steroid hormones:Conversion of cholesterol to steroid hormone.Steroid receptors: isolation and characterization of steroid receptors. Receptor downregulation, desensitization, and upregulation.

Pineal gland, melatonin, and circadian rhythm.

Chemistry and action of prostaglandins, prostacyclins, and thromoxanes.

Newly discovered hormones

References:

Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G (All Editions).
Molecular and Cellular Biology by Lodish and others (All Editions).
Molecular Biology of the Cell by Alberts and others (All Editions).

Biostatistics - 3 Credits 48 h

Objectives are:

- To study the sampling techniques and significance of biostatistics.
- To study the collection and representation of statistical data.
- To study the applications of various means of statistical analysis.

Course outcome: the student will:

- Understand the collection and graphical representation of statistical analysis.
- Understand the sample size and hypothesis testing.
- Understand the various means of statistical analysis, including t-test, ANOVA, correlation, and regression.

Unit-1:

Introduction to Biostatistics: Population, sample, sampling techniques, random sample. Mean, median, mode, range, variance, coefficient of variation, frequency, standard deviation, standard error.

Unit-2:
Collection of data: Relevance of sample size. Sources, methods, questionnaires, records, archives, scaling-Likert, and Gutman. Validation and standardization of the methods, modification, and experimental design. Representation of statistical data: line graph, histogram, bar diagram, pie chart, scatter diagram.

Unit-3:
Probability: Rules of probability, binomial distribution, normal distribution, area under the curve, Z value, choosing sample size, hypothesis testing, Student's t test. One-way ANOVA, correlation, and regression.

Unit-4:
X2 test: goodness of fit, test of independence.
Non-parametric statistics, the sign test, the rank sum test, and rank correlation.
References:
Introduction to the practice of statistics by David S. Moore and others.
Introduction to the practice by Mehdi Razzaghi and others.
Statistics by K R Gupta.

Genomics and Proteomics - 3 Credits 48 h

Objectives are:
- To study the basics of genomics and proteomics through bioinformatics.
- To study various databases and servers involved.
- To study molecular modeling and drug designing.

Course outcome: the student will:
- Understand the biological databases and related software employed to analyze DNA sequences, protein sequences,
- Understand the generation and prediction of different molecular structural models from the available data.
- Understand molecular phylogenetics based on the existing sequence data
- Understand proteomics and sequence analysis using various software.
- Understand designing a drug and its interaction with the ligands.

Unit-1:
Introduction to Genomics: DNA isolation, sequencing by the dideoxy method, and next-generation sequence analysis. Hybridization methods, microarray analysis, and reverse transcribed and real-time PCR.
Biological databases: Introduction, classification of biological databases, and retrieval of biological database systems. Molecular Modelling Database at NCBI, Molecular visualization software (RASMOL). Phylogenetics Clustal. Prediction of genes (Gene Finder, ORF Finder).

Unit-2:
Sequence comparison and database search: Introduction, pairwise alignment, global alignment, local alignment, multiple sequence alignment, scoring a multiple alignment,

multiple sequence alignment, methods-dynamic programming approach, progressive alignment, iterative refinement methods, pattern matching in DNA and protein sequences, PAM matrices, BLAST, FAST, and FASTA. Nucleotide sequence analysis, tools and methods, single-nucleotide polymorphism.
Molecular phylogenetics: Introduction, application of phylogenetic trees, basic terminology, taxa, taxonomy, root, leaf, node, tree, branch, clade, dendrogram, cladogram, rooted tree, unrooted tree, scaled tree. Philip, Clustal.

Unit-3:
Introduction to proteomics: Analytical methods of protein and peptide separations, protein digestion techniques, and mass spectrometers for protein and peptide analysis. Protein identification by peptide mass fingerprints, peptide sequence analysis by tandem mass spectrometry.
Protein sequence analysis using software**:** Emboss, data mining proteomes, motif mapping using Prosite, Prodom, protein expression profiling, protein-protein interactions, protein complexes. Mapping protein modifications. Protein secondary structure analysis, Molecular visualization, protein 3D structure using Rasmol, and pdb file format.

Unit – 4:
Protein and secondary structure prediction: Secondary structure prediction methods, software for secondary structure prediction, protein families and classification, prediction of transmembrane regions. CATH and SCOP.
Protein modelling: Introduction, methods of protein modelling, homology or comparative modelling, model refinement, and evaluation of the model.
References.
Structural Proteomics: High-Throughput Methods (Methods in Molecular Biology)" by Bostjan Kobe and Mitchell Guss.
Genomics of Plant-Associated Bacteria" by Dennis C Gross and Ann Lichens-Park.
Introduction to Proteomics: Tools for the New Biology" by Daniel Liebler.
Principles of Proteomics (Advanced Texts)" by Richard Twyman.
Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G(All Editions).
Molecular Cell Biology by Lodish and others (All Editions).
Genes by Benjamin Lewin.
Molecular Biology of the Cell by Alberts and others (All Editions).

III Semester Biochemistry

Courses - Hard Cores

GenomeOrganization and itsReplication - 3 Credits 48 h

Objectives are:

- To study the basics of molecular biology.
- To study the molecular mechanisms involved in the storage of information and transfer of information from one generation to the next generation.

Course outcome: the student will:

- Understand the historical discovery made and the methodology employed to establish that DNA is the genetic material.
- Understand the molecular process of transcription and translation while transferring genetic information from DNA to protein via RNA molecules.
- Understand the enzymatic steps involved in each process and their regulations.

Unit – 1:

Introduction:Historical perspective, composition of RNA and DNA. Bases, Chargaff's rule. Types of RNA. Isolation and purification of RNA and DNA, structure of RNA and DNA, central dogma of molecular biology. Structure of bacterial chromosome, structure of eukaryotic chromosome, nucleosome organization, and arrangement of chromatin fibers in a chromosome. Genome size and evolutionary complexity:the C-value paradox.

Unit - 2:

DNA-antiparallel nature:Nearest neighbour base frequency analysis. Replication of DNA – modes (unidirectional, bi-directional), semi-conservative nature; Messelson and Stahl experiment.

Replication of double-stranded DNA, direction of replication, discontinuous replication, and Okazaki fragments.Different models of replication.

Unit-3:

Prokaryotic and Eukaryotic DNA polymerase I, II, and III (proofreading activity), DNA ligase, DNA topoisomerases, DNA primase, and DNA helicase. DNA damage and repair mechanism. Fidelity of replication. Replication in viruses, rolling circle model, single-stranded DNA virus. Applications of mitochondrial DNA. Trombone model, translesion synthesis (DNA pol IV and V).

Unit-4:

Regulation of gene expression in prokaryotes: Operon model; lac operon, structure and regulation. Galactose operon: role of two promoters. Arabinose operon; positive control. Tryptophan operon; T attenuation control.

Eukaryotic gene regulation:Regulation of gene expression at the level of DNA structure; super coiling, DNA methylation. Role of nucleosome structure in enkaryotic gene expression; glucocorticoid gene, DNA kinking, bending, and gene regulation. Chromatin structure, chromatin remodeling, Swi/Snf, remodeling assay, ChIP.

References:

DNA Replication by Arthur Kornberg.
Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G(All Editions).

Molecular Cell Biology by Lodish and others (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Genes by Benjamin Lewin.
Molecular Biology of the Cell by Alberts and others (All Editions).

Transcription, Translation, and Regulation - 3 Credits,48 h

Objectives are:

- To study basic genetics and the regulations of genetic materials.
- To study chromosomal aberrations, repair mechanisms, and genetic disorders.

Course outcome: the student will:

- Understand the early genetic work from Mendelian laws up to recent molecular studies of genetic principles.
- Understand the various aberration processes and the repair mechanism.
- Understand the regulations of genes in both prokaryotes and eukaryotes.
- Understand the genetic disorders.

Unit – 1:

Transcription:Co-linearity of genes and proteins, RNA polymerase I, II and III. Activators, enhancers, repressors of transcription, transcription factors, RNA biosynthesis in prokaryotes and eukaryotes; initiation – regulatory elements, formation of pre-initiation complex, elongation, and termination., RNA-dependent RNA synthesis, RNA replicase of Qβ virus. Processing of eukaryotic RNA, cap addition, poly A tail addition, and RNA editing. Processing of tRNA and mRNA transcripts.

Unit – 2:

Regulation at the level of transcription:Transcription factors, TF II, NFkB, regulation of NFkB, and its activation. Formation of the initiation complex. Role of enhancer.
Regulation at the level of RNA processing: RNA export and RNA stability, factors affecting RNA stability, and RNA degradation.

Unit - 3

Translation:Genetic code, triplet codon, universality features of the genetic code, assignment of codons, studies of Khorana, Nirenberg, triplet binding techniques, degeneracy, wobble hypothesis, evolution of the genetic code and codon usage, variation in the codon usage. 3D structure of prokaryotic and eukaryotic ribosomes, ribosomal protein synthesis; initiation- charging of tRNA, formation of initiation complex (40S & 80S), recognition of initiation codon, regulation of initiation, elongation (binding of aminoacyl tRNA to A site; Peptide bond formation; Translocation), and termination; recycling of ribosomes. Role of mRNA and tRNA. Aminoacyl tRNA and its role in translation accuracy.
Post-translational modification of proteins, signal cleavage, disulphide bond formation, O and N-glycosylation, folding of nascent protein, types and role of chaperones, attachment of glycosyl anchor, and other modifications. Protein misfolding and associated disorders
Enzymes in DNA and RNA degradation: Nucleases, ribonucleases, classification and role.

Unit – 4:
Regulation at the level of translation:Secondary structure in the 5' and 3' untranslated region; regulation of ferretin and transferring, mRNA. Role of upstream AUG codons. (GCN 4 gene regulation), transplanting and translational introns, protein splicing inteins. Role of aminoacyl t-RNA synthetase in the regulation of the accuracy of translation, the proof-reading mechanism. Ribosomal optimization of translation. Regulation at the level of ribosome assembly.Regulation at the level of post-translational modification: protein stability, N-end rule, PEST and other sequences, ubiquitin-mediated degradation.

References:

Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G(All Editions).
Molecular Cell Biology by Lodish and others (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Genes by Benjamin Lewin (All Editions).
Molecular Biology of the Cell by Alberts and others (All Editions).

Clinical biochemistry - 3 Credits 48 h

Objectives are:

- To study the basics of health and diseases.
- To study diseases associated with the blood, liver, kidney, gastrointestinal system, and endocrine system.
- To study metabolic disorders

Course outcome: the student will:

- Understand the concept of health and diseases with respect to infectious and non-communicable diseases
- Understand the various investigations to study the disorders of the blood, liver, kidney, gastrointestinal system, and endocrine system.
- Understand metabolic disorders with respect to diabetes and coronary heart disease.
- Understand the hypo- and hyperactivities of all the endocrine organs and their manifestation in various disorders.

Unit-1:
Basic concepts**:** Health and disease. Normal and pathological changes affecting cells in the body. Cell death and the physiological causes: physical, chemical, biological agents, and nutritional deficiency.
Blood: Composition in clinical conditions, cells, functions of plasma proteins and lipoproteins in diseases. Disorders of hemoglobin: thalassemia, sickle cell anemia.
Anemias: microcytic, normocytic, and macrocytic.
Diagnostic enzymology: Clinically important enzymes; alkaline phosphatase, AST, ALT, and isoenzymes of creatine kinase and LDH.

Unit-2:
Endocrine disorders:Laboratory diagnosis to assess the function of the pituitary, thyroid, adrenals, and gonads.
Disroders: Graves' disease, Hashimoto's disease, Addison's disease, hypo and hyper secretion of hormones. Acromegaly, gigantism.
Liver:Biochemical indices of hepatobiliary diseases. Diagnosis of liver function tests. Bile pigments - formation of bilirubin, urobilinogen, and bile acids.
Jaundice; prephapatic, hepatic, and posthepatic.
Diseases of the liver - Hepatitis, cholestasis, cirrhosis, fatty liver, and gallstones. cystic fibrosis. Mechanism of detoxification of xenobiotics.
Kidney:Assessment of renal function; creatine clearance, renal calculi, uremia, laboratory investigation of kidney disorders.

Unit-3:
Gastrointestinal disorders: Fractional gastric analysis, hypo and hyper-acidity, gastric ulcers, malabsorption syndrome, steatorrhea, and diarrhoea.
Diabetes mellitus: classification, etiology, management. Laboratory investigations: GTT, HbAlc, diabetic complications, and advanced glycation end products.
Glycogen storage diseases, galactosemia, lactose intolerance, and pentosuria.

Unit-4:
Cardiovascular disorders:Major Cardiovascular system, atherosclerosis, risk factors, and pathogenesis. Diagnosis and prognosis.
Determination of lipids and lipoproteins. Hyperlipoproteinaemia and types of modification of lipoproteins. Tay-Sachs, Niemann-Pick disease, Fabry's disease.
Cancer:Etiology, diagnosis, treatment, and prognosis. Carcinogens, oncogens, and mechanisms. Biochemistry of ageing: Cellular senescence,

References:
Textbook of Medical Physiology by Guyton and others (All Editions).
Textbook of Biochemistry with Clinical Correlations by Devlin (All Editions).
Medical Biochemistry at a Glance by J G Salway (All Editions).
Harper`s Illustrated Biochemistry by Murray and others (All Editions).
Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G(All Editions).
Molecular Cell Biology by Lodish and others (All Editions).
Textbook of Biochemistry by Devlin (All Editions).

Practical-3:
Experiments in Molecular Biology& Clinical Biochemistry-4 Credits 8 h/week

Objectives are:

- To develop skills in the practical components and to learn good laboratory practices
- To learn colorimetric estimation of metabolites.
- To learn assays if clinically significant enzymes.
- To develop skills for seminar presentation.

Course outcome: the student will:

- Understand the clinical significance of measuring various metabolites such as glucose, pyruvate, ascorbic acid, iron, calcium, and phosphorus.
- Understand different functional analyses such as lipid profile, diabetes profile, liver and kidney profile.
- Develop the art of presentation during the seminar, which will help in developing skills for the teaching profession.

Estimation of pyruvate, ascorbic acid, iron, calcium, phosphorus,
Lipid profile: Total cholesterol, Triglycerides in serum.
Diabetic profile: Fasting blood sugar, post-prandial blood sugar, GTT by GOD and POD method.
Renal function test: Urea and creatinine.
Liver function test: Bilirubin, SGOT, SGPT, Alkaline Phosphatase, LDH, Albumin and globulin ratio.
Isolation of DNA and RNA from plant and animal sources, purity of DNA
Assay of DNA, electrophoresis of DNA and RNA.

References:

Biochemistry: Solutions Manual by J Stenesh.
Practical manual in Biochemistry and Clinical Biochemistry by Victor J Temple.

Courses: Soft cores

Genetic Engineering - 3 Credits 48 h

Objectives are:

- To study the basics of recombinant DNA technology.
- To study the applications of various plasmids/vectors and PCR technique in cloning.
- To study the importance and applications of transgenic animals and plants.

Course outcome: the student will:

- Understand the principle and methodology employed in DNA recombinant technology.
- Understand the various plasmids/vectors in cloning.
- Understand the importance of restriction enzymes and ligation enzymes in the process of cloning.
- Understand the applications of transgenic animals, plants, gene therapy, and their negative impact.

Unit-1:
Genetic Engineering: Definition, aims and objectives of recombinant DNA technology, restriction-modification systems, restriction enzymes, discovery, type I, II, and III, specificity, sticky ends and blunt ends, isoschizomers.

Unit-2:
Vectors: Plasmids, phage, cosmids, and phagemid. Yeast cloning vectors, plant vectors, bacterial artificial chromosome, SV40, shuttle vectors, and the construction of expression vectors. Blunt end and sticky end ligation, use of linkers and adaptors, homo polymer tailing, Gene cloning, genomic cloning, shotgun cloning, cDNA cloning. CRISPR / Cas technology:Micro injection, electroporation, lipofection, and the calcium phosphate method.

Unit-3:
Identifying the right clones: Direct screening; insertional inactivation of marker gene, visual screening, plaque phenotype. Indirect screening: immunological techniques, hybrid arrest translation, hybrid selection translation
DNA sequencing by different methods, Next-generation sequencing, PCR, analysis of products, and applications of PCR in cloning. RT-PCR technique and applications. Real-time PCR for quantification.

Unit-4:
Bacterial transformation and transduction, conjugation; F+ plasmids, Hfr cells, time of entry mapping. Arrangement of genes in the phage chromosome, plaque formation, and lytic cycle.

References:

Molecular Cloning by Sambrook and Russel (All Editions).
An Introduction to Genetic Engineering by Desmond S. T. Nicholl (All Editions).Genetic Engineering: Principles and Methods by Jane K. Setlow (All Editions)
Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G(All Editions).
Molecular Cell Biology by Lodish and others (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Genes by Benjamin Lewin (All Editions).
Molecular Biology of the Cell by Alberts and others (All Editions).

Plant Biotechnology – 2 Credits 32 h

Objectives are:

- To study the basics of protoplast technology.
- To study different plant transformation techniques.
- To study transgenic plants.

Course outcome: the student will:

- Understand the principle and methodology employed in protoplast technology.
- Understand the various methods of germplasm preservation.
- Understand the importance of Agrobacterium-mediated DNA transfer.
- Understand improved crop production.

Unit 1:
Protoplast Technology: Isolation, purification, and culture of protoplasts, protoplast fusion and somatic hybridization, applications of somatic hybrids/ cybrids. Bioreactors and types of bioreactors. Callus Induction, Organogenesis, Somatic embryogenesis, cell suspension culture, and synthetic seeds. Tissue-specific hormones.

Unit 2:
Germplasm preservation: Preservation of seed-propagated species, preservation of pollen, preservation of vegetatively propagated species, pre-treatment of plant and propagule, cryopreservation, cryoprotectant, Biotransformation using plant cell culture. Micropropagation: Propagation from pre-existing meristem, shoot apical meristem, shoot and node culture, micropropagation stages, and applications.

Unit 3:
Plant transformation techniques: Methods of gene transfer in plants, Agrobacterium-mediated transfer- mechanism of DNA transfer. General features of Ti and Ri plasmids,
Molecular farming: production of alkaloids, steroids, colouring agents, flavoring agents, biodegradable plastics, industrial enzymes, therapeutic proteins, biopharmaceuticals, edible vaccines, plantibodies.

Unit 4:
Transgenic plants: Herbicide resistance, resistance against biotic stress- bacterial, viral, fungal, and insect resistance, improved crop productivity, improved nutritional quality, transgenic plants for floriculture, Qualitative trait loci and marker studies.

References:

Plant Biotechnology by B. D. Singh
Industrial Biotechnology: Plant Systems, Resources and Products by Mukesh Yadav and others (All Editions).
Plant Biotechnology by Zareen Narayanan and Bernard R Glick.
Plant Biotechnology: Principles and Applications by Malik Zainul Abdin and others.
Molecular Biology of the Cell by Alberts and others (All Editions).

Animal Biotechnology – 2 Credits 32 hours

Objectives are:
- To study animal cell and tissue culture techniques.
- To study cloning techniques.
- To study the importance of animal cell and tissue culture, and the cloning process.

Course outcome: the student will:

- Understand the principles and methodology employed in animal cell and tissue culture.
- Understand various model systems employed in animal biotechnology.

Unit 1:
Culture of animal cells: Advantages and limitations of tissue culture, aseptic handling, and facilities required for media and cell lines. Primary culture: Isolation of mouse and chick embryos, human biopsies, methods for primary culture, propagation, immortalization of cell lines, selection of cell lines, and routine maintenance.

Unit 2:
Cell quantitation, cell culture contamination: monitoring and eradication, cryopreservation. Culturing of specialized cells: Epithelial, mesenchymal, neuroectodermal, hematopoietic, gonad and tumor cells, lymphocyte preparation, culture of amniocytes, fish cells, Stem cell culture and its applications.

Unit 3:
Cloning and Selection: Cloning protocol, stimulation of plating efficiency, suspension cloning, isolation of clones, isolation of genetic variants, interaction with substrate, and selective inhibitors. Cell separation and characterization: Density-based, antibody-based, magnetic, and fluorescence-based cell sorting. Characterization of cells based on morphology, chromosome analysis, DNA content, RNA and protein, enzyme activity, antigenic markers, cytotoxicity assays.

Unit 4:
Cloning of Animals: Methods and Uses. Introduction, nuclear transfer for cloning, cloning from embryonic cells, and adult and fetal cells. Cloning from short-term cultured cells. Cloning from long-term cultured cells. Cloning efficiency, cloning for production of transgenic animals, gene targeting for cloned transgenic animals, and cloning for conservation.

References:

Molecular Biology of the Cell by Alberts and others (All Editions).
Textbook of Animal Biotechnology by B. Singh and others
Animal Biotechnology by N. Arumugam and V. Kumaresan
Biotechnology: Animal Biotechnology by U. Sathyanarayana and B. Chakrapani

Courses - Open Electives

Fundamentals of Biochemistry - 4 Credits 48 h

Objectives are:

- To study the basics of vital physiology.
- To study the key biomolecules involved in exerting physiological functions.

Course outcome: the student will:

- Understand the significance of blood and its components for physiological functions.
- Understand the physiology of the nervous system, digestive system, and muscle physiology.
- Understand the nutritional aspects of sugars, proteins, amino acids, lipids, nucleic acids, minerals, and vitamins.
- Understand the toxicity of xenobiotics used as medications to cure diseases.

Unit-1:

Blood:Composition, cell types, red blood cells, white blood cells, and their function. Hemostasis, blood clotting, digestion of clot, anticoagulants, blood volume, blood pressure, and serum enzymes.

Respiratory System: Lungs, structure and functions, exchange of gases,

Unit-2:

Excretory System:Ultrastructure of the nephron, formation of urine.

Hepatobiliary System: Anatomy of the liver, cell types. Secretory and excretory function and formation of bile.

Digestive System: GI tract, digestion, and absorption of carbohydrates, proteins, and lipids. Function of HCl

Muscle physiology: Skeletal muscle and smooth muscle, muscle proteins.

Unit-3:

Nutrition:Small molecules: sugars, amino acids, nucleotides, lipids. Macromolecules: polysaccharides, proteins, nucleic acids.

Carbohydrates: Dietary sources, dietary fiber, and essentiality of carbohydrates.

Proteins: Essential amino acids, nutritional classification of proteins, supplementary value of proteins, protein malnutrition.

Fats:Sources, invisible fat, essential fatty acids, PUFA.

Vitamins: Classification, source, deficiency symptoms. Fat-soluble and water-soluble vitamins.

Unit-4:

Minerals and Water Metabolism:Macro and micronutrients, sources, requirements, functions, and deficiency symptoms. Water metabolism: distribution in the body, water balances, and factors affecting water balance.

Implications in health and disease: Diabetes,Hypertension, Hypotension

Gouty arthritis,

Immunology: Historical development and milestones in immunology Vaccines and Vaccination.

Toxicity: Xenobiotics, heavy metals, pesticide poisoning.

Tutorials: Discussion, demonstration, laboratory visits.

References:

Devlin′s Textbook of Biochemistry with Clinical Correlations (All Editions).
Medical Biochemistry at a Glance by J G Salway (All Editions).
Harper`s Illustrated Biochemistry by Murray and others (All Editions).
Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).

Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G(All Editions).

IV Semester Biochemistry

Courses - Hard Cores

Immunology - 3 Credits 48 h

Objectives are:

- To study the basics of the defense system.
- To study the cellular basis and humoral basis of immunity
- To study the immunesystem during transplantation

Course outcome: the student will:

- Understand the basics involved in cell-mediated and humoral-mediateddefensemechanisms.
- Understand primary and secondary immune response in cell-mediated responses and production of cytokines and co-stimulatory molecules in humoral-immune responses.
- Understand the biochemical process involved during transplantation, vaccination, and tumor formation and evasion

Unit-1:

Introduction:Detailed Historical development and milestones of discoveries in immunology. Definitions: antigenicity, immunogenicity, innate and acquired immunity. Barriers, cells, and agents of innate immunity, the role of the complement system, PRR, and DAMPs. Primary and secondary lymphoid organs, self and nonself discrimination. Antigens and antibodies; haptens and determinants, epitopes and paratopes. Antigenicity, carbohydrates, proteins, nucleic acids, and cells as antigens. Valency of antigen, epitope structure.

Classes and subclasses of immunoglobulins, structure of immunoglobulins, hyper-variable region, isotypic, allotypic, and idiotypic variation.

Unit-2:

Cellular Basis of Immunity: Primary and secondary immune response. Reticuloendothelial system, B and T, and accessory cells. Development of B and T cells. Subsets of B and T cells. T-helper cells, T-killer cells, T-suppressor cells. B and T cell receptors, antigen processing and presentation. B and T interaction. Cytokines and co-stimulatory molecules; lymphokines, interleukins, structure and function of IL-lβ, IL-2, TNFα. Immune tolerance, Suppression of immune response, immunoglobulin genes, generation of immunoglobulin diversity, gene rearrangement, and other mechanisms, the clonal selection theory of Burnet.

Unit-3:

MHC: MHC gene and its polymorphism, role of MHCmolecules in immune response and transplantation.

Transplantation:Autograft, isograft, allograft, and xenograft. Mechanism of graft rejection, graft vs. host reaction. Immunosuppressive drugs.
Tumour immunology:Tumor antigens, tumor-specific, and tumor-associated antigens, factors favoring tumour growth, and immune surveillance. Tumour necrosis factor α and β. Antitumour drugs, different types of cancer therapies.

Unit-4:
Disorders of immunity: Immunological tolerance, autoimmune disorders, immunodeficiency disorders, AIDS, SCID.Systemic Lupus Erythematosus. Hypersensitivity, different types, anaphylaxis, and molecular mechanisms.
Vaccines: Adjuvants, vaccines, and their preparations. Polyclonal and monoclonal antibodies; hybridoma technique.
In vitro antigen-antibody reaction:Precipitation, agglutination, complement fixation, immuno diffusion, immunoelectrophoresis, immunofluorescence, RIA, ELISA. Antibody purification- theory.
References:
Kuby Immunology by Kindt, Goldsby and Osborne (All Editions).
Immunology by Roitt, Brostoff and Male (All Editions).
Immuno Biology by Janeway and Travers (All Editions).
Cellular and Molecular Immunology by Abbas, Lichtman, and Pillai (All Editions).

Cell Biology and Genetics - 3 Credits 48 h

Objectives are:
- To study the molecular architecture of a cell.
- To study the functions of cells, their division, and the importance of genes.

Course outcome: the student will:
- Understand the basic structure and function of eukaryotic cells.
- Understand the mechanism of inheritance.
- Understand the mechanisms of chromosomal damage and repair.

Unit-1:
Ultra-structure of prokaryotic and eukaryotic cells: chemical organization of the cell; intracellular organelles: endoplasmic reticulum, Golgi apparatus, mitochondria, chloroplast, lysosomes, and Nucleus - Internal organization, nucleosomes, chromatin-structure and function, cellular cytoskeleton. Cell-cell and cell-ECM interaction and ECM structure and function.

Unit- 2:
Cell cycle and its regulation: Cell division- mitosis, meiosis, cytokinesis, and karyokinesis. Cyclins and cyclin-dependent kinases, Checkpoints- role of Retinoblastoma (Rb) and p53, apoptosis. Chromosome number: Types of Ploidies, karyotyping, sex chromosomes, dosage compensation, mobile genetic elements.

Unit- 3:

Basic principles of Mendelism, Gene linkage and chromosome: Linkage and recombination of genes in a chromosome. X-linked inheritance, polygenic inheritance, mitochondrial inheritance, Y-linked inheritance, and map unit. Chromosomal basis of human diseases: Extra or missing chromosome, abnormality in chromosome structure; deletion, duplication, inversion, and translocation. Repair mechanism: Reciprocal recombination, site-specific recombination, E. coli rec system, Holiday model of recombination.

Unit- 4:

Molecular genetics: Mutations, nature of mutations, spontaneous and induced mutation, conditional, lethal (temperature sensitive) mutation, biochemical basis of mutation, Point mutation, base substitution mutation, missense, nonsense, and silent mutation. Mutation rates, chemical mutagens, radiation-induced mutation, reverse mutation, and suppressor mutations-intergenic and intragenic suppression, reversion as a means of detecting mutagens.

References:

Genetics by Jenkins.
Genes by Benjamin Lewin (All Editions).
Genetic Analysis by Anthony J F Griffiths and others (All Editions)
Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G (All Editions).
Molecular and Cellular Biology by Lodish and others (All Editions).
Molecular Biology of the Cell by Alberts and others (All Editions).

Practical- 4: Experiments in Immunology and Genetic Engineering -4 Credits 8 h/week

Objectives are:

- To study the techniques involved in manipulating DNA.
- To study the techniques involved in determining antigen and antibody.

Course outcome: the student will:

- Understand the procedures involved in isolating nucleic acid from different biological samples.
- Understand the use and applications of different enzymes in manipulating nucleic acids using the prokaryotic system.
- Understanding antigen and antibody reactions.

Preparation of media, culturing of transgenic *E.coli* and Yeast. Preparation of competent cells. Isolation of plasmids, ligation, and transformation. Restriction digestion of DNA.
PCR: Primer design and amplification. RT-PCR, blotting.
Blood grouping.Purification ofantibody from egg yolk. Ouchterlony diffusion test
Western blot and ELISA.

References: Molecular Cloning by Sambrook and Russell.

Courses - Soft Cores

Project work - Soft core- 3 Credits 12 h/week

Objectives are:

- To address a small research problem.
- To design and interpret the results.

Course outcome: the student will:

- Understand designing experiments based on the research problem.
- Understand compiling and analyzing data.
- Be able to write a comprehensive project report.

Project work: Project work will be on a defined research topic allotted to the students. The project work includes designing experiments, generating results, analyzing results, and writing a comprehensive project report and the defence before examiners.

Students may carry out the project work in-house or outside the department.

Note: Theory and practical classes may be adjusted during the fourth semester to encourage students to take up the project work.

Bioprocessing, Biosafety, and Ethics- 3 Credits 48 h

Objectives are:

- To study the basics of bioprocessing.
- To study scale-up and scale-down industrial processes.
- To study biosafety and bioethics.

Course outcome: the student will:

- Understand the basics involved in bioprocessing techniques, and bioreactors.
- Understand the large-scale production of biological molecules of human and animal importance.
- Understand the biosafety and bioethics of the generation of genetically modified organisms.

Unit 1:

Basic principles of bioprocessing: Isolation, screening, and maintenance of industrially important microbes, microbial growth factors affecting microbial growth, strain improvement for increased yield, and other desirable characteristics.

Bioreactor design and operation: batch and continuous fermentation, fed-batch, chemostat with recycle, multistage chemostat systems.

criteria for ideal fermenter; configuration; bioreactor designs, mechanically agitated; pneumatic and hydrodynamic fermenters. whole cell immobilized fermenters, stability of microbial reactors.

Unit 2:

Enzymes from microbial sources, large-scale production of enzymes, recovery of enzymes, enzyme purification methods- enzyme precipitation, separation by chromatography, enzyme reactors.

Immobilized enzymes: Physical and chemical methods of immobilization, immobilization supports, kinetics of immobilized enzymes. Enzyme catalysis in apolar media, reverse micellar entrapment of enzymes, and their applications. Application of enzymes: synthesis of chemicals using enzymes,food technology, and medicine. Enzymes in diagnostic assays.

Unit 3:

Upstream processing: fermentation media; media formulation; sterilization; aeration, agitation, and heat transfer in bioprocess; measurement and control of bioprocess parameters; scale-up and scale-down process

Separation of insoluble factors: filtration, centrifugation, sedimentation; cell disruption.

Downstream processing and product recovery: separation of solubles: liquid-liquid extraction; precipitation; chromatographic techniques; reverse osmosis and ultra and micro filtration; final purification: drying; crystallization; storage and packaging; effluent treatment and its disposal.

Commercial products of microbes: Antibiotics, biopolymers, vitamins, organic acids, biosensors, biopesticides, and the production of biofuels.

Unit-4

Biosafety, regulations, guidelines for the production of genetically modified organisms, and awareness on producing transgenic organisms.

Bioethical issues, scope, and definition. Ethical issues in health care systems and biological research.

Intellectual property rights and patent laws.

References

Molecular Biology of the Cell by Alberts and others (All Editions).
Molecular Cell Biology by Lodish and others (All Editions).
An introduction to genetic analysis by Griffith A J and Macmillan.
Plant Biotechnology: The Genetic Manipulation of Plants by Halford, Adrian Slater and others.
Biotechnology: a textbook of industrial microbiology by Crueger W, andCrueger. A
From genes to clones: introduction to gene technology by VCH Verlagsgesellschaft.
Molecular cloning: a laboratory manual.
Principles of gene manipulation and genomics byPrimrose SB, Twyman R.
Route maps in gene technology byWalker M, and Rapley R.
Concepts in biotechnology: Universities Press by Bryce C, Balasubramanian D.
Gene cloning and DNA analysis: an introduction byBrown T.
Biosafety Manual For Microbiology Laboratory by Befekadu Teshome.
Biological Safety: Principles and Practices (ASM Books), by Dawn P., Wooley, and Karen B Byers.

Courses- Open Electives

Clinical Diagnosis in Health and Disease– 4 Credits, 48 h

Objectives are:
• To study the basics of health and disease conditions.
• To study clinical investigations for diagnosis and their awareness.

Course outcome the student will:
• Understand general health and disease state.
• Understand the difference between communicable diseases and non-communicable disease and precautionary measures to prevent the same.
• Understand different investigation procedure involved in diagnosis.

Unit-1:
Introduction: General health, syndrome and common diseases – communicable and non-communicable diseases. Samples for analysis: Blood, urine, pleural fluid, synovial fluid, cerebrospinal fluid and tissues and histology. General check-up: Blood group, Hb, height and weight, waist to hip ratio, electrocardiogram, X-ray, abdomen scan and appearance of scars, urine analysis – routine analysis (protein, sugar, pigments and cells). Special test – detection of metabolites and its importance.

Unit-2:
Tests for liver function: Enzyme assay (SGOT, SGPT, Alkaline phosphatase, GGT), Total protein, albumin / globulin ratio and their significance. Test for kidney function: Urea and creatinine estimation and their significance. Test for heart function: Blood pressure (cystolic and diastolic), lipid profile (cholesterol, triglycerides, HDL, LDL estimation) and their importance. Test for lung function: Chest X-ray, Spirometry. Test for Brain function: EEG, MRI, CT. Test for Surgery: Bleeding time, clotting time.

Unit-3:
Infection: Bacterial, viral, fungal and protozoans. Blood: Total cell count, differential count, erythrocyte sedimentation rate. Infectious diseases: Tuberculosis, Leprosy, Malaria, Hepatitis, Cholera, Dengue, HIV, Chikungunya and H1N1. TORCH- Panel (infertility profile), Infection in pregnancy, Koch postulations- microscopic examination of body fluids, ELISA and PCR tests.

Unit-4:
Non communicable diseases: Diabetes: Blood sugar, urine sugar, glucose tolerance test, HbA1c. Hypertension: Lipid profile, electrolyte (sodium, potassium, chloride and bicarbonate) investigation. Special test: X-ray, CT, MRI, Doppler, TMT, angioplasty. Cancer markers: ELISA. Professional hazard: High risk groups (Farmers, heavy duty machine workers, CEOs, athletes). Doping in sports; Drug addiction.
Tutorials: Discussion, demonstration, laboratory visits

References:

Textbook of Medical Physiology by Guyton and others (All Editions).
Textbook of Biochemistry with Clinical Correlations by Devlin (All Editions).
Medical Biochemistry at a Glance by J G Salway (All Editions).
Harper`s Illustrated Biochemistry by Murray and others (All Editions).
Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).

Special Note: To achieve academic competence, students are advised to read and assimilate the current information related to new developments and cutting-edge technologies published in various journals.

Question paper pattern

Theory Question Paper Pattern for M.Sc. Degree in Biochemistry (3 Credit Courses)

Time: 3 hours **Maximum Marks:** 70

Instruction: Answer question number 01 and any four from the remaining.

1) Answer any seven questions briefly: 7x2=14
   a) to j).

Questions from 02 to 07, each carry 14 marks.
These questions may contain sub questions, and some may be short notes, example,

2) a) 7+4+3=14
   b)
   c)

3) a) 7+7=14
   b)

4) a)
   b)
   c)

5)

6)

7) Write short notes on:
   a)
   b)
   c)

Theory Question Paper Pattern for M.Sc. Degree in Biochemistry (2 Credit Courses)

Time: 2.5 hours **Maximum Marks:** 35

Instruction: Answer question number 01 and any four from the remaining.

1) Answer any seven questions only: 7x1=7
   a)to j).

Questions from 02 to 07, each carry 7 marks.

These questions may contain sub questions, and some may be short notes, example,

2) a) 4+3=7
   b)

3) a) 3+2+2=7
   b)
   c)

4) a)
   b)
   c)

5)

6)

7) Write short notes on: a), b), c).

Practical'sQuestion Paper Pattern for M.Sc. Degree in Biochemistry (4 Credit Course)

Time:6 hours **Maximum Marks:**70

1.	Protocol writing (First 10 min).	10 marks
2.	Major experiment (Estimation-quantitative).	25 marks
3.	Minor experiment (Estimation/analysis-qualitative or quantitative.	10 marks
4.	Record.	10 marks
5.	Viva.	10 marks.

Project work evaluation

The student shall submit the report (The report includes introduction, aim and scope, materials and methods, results, discussion, conclusion, and references) for evaluation. Evaluation may be in the form of a viva or a presentation.

Department of Studies in Biochemistry
University of Mysore, Mysuru.

Course: Ph.D. Degree in Biochemistry
Course work Syllabus
March 2026
Total Credits = 12

Programme objectives

The main objective of this Ph.D. Degree programme is to provide a strong foundation to

- To understand the basic problems in the current research scenario and find meaningful solutions.
- To develop as an independent researcher both in academic institutions and in R & D programmes of industries.
- To take up research problems at a higher level to work as a postdoctoral fellow worldwide.
- To take up the teaching profession in academic institutions

Programme Outcomes

On successful completion of this programme, each Ph.D. scholar will:

- Have thorough knowledge of current literature in the specified area.
- Know how to design experiments to address the chosen research problem.
- Have confidence to write publications in peer-reviewed journals.
- Have the knowledge to take up research and teaching independently.

Course No.	Course Title	Internal Assessment (C1 + C2)	C3 Assessment	Max. Marks	Min. Marks	Credits	Duration of Exam
I	Research Methodology	15+15=30	70	100	50	4	3 hrs
II	Research and Publication Ethics	10+10=20	30	50	25	2	2 hrs
III	Review of Literature (Broad Area)	15+15=30	70 (Report+Viva)	100	50	6	

Paper-I. Research Methodology- 4 Credits

Objectives are:

- To learn types of research.
- To learn about various research models with the use of advanced techniques
- To learn about good laboratory practices and ethical issues.

- To learnthe applications of suitable statistical analysis.

Course outcome: The research student will:

- Understand the use of appropriate biological samplesor animal models to address the selected research problem
- Understand the applications of advanced techniques.
- Understand the signaling pathways at the cellular level.

Unit-1

Types of Research- Academic, Industrial, Clinical, Basic research, and applied research. Research objectives. Review of literature-identifying gaps; formulating hypotheses, in selecting research topics.

Collection of Research Material: Information, types, and sources. Pubmed as a resource. Collection, classification, and retrieval of information.

Research Design: Types of studies-cohort, double blind, placebo-controlled, crossover. Overview of Framingham study.

Statistical methods: Error and its significance, choosing sample size, collection of data-questionnaire; methods of scaling, collection analysis, and presentation of data. Parametric and non-parametric tests, and when to use them.

Unit-2

Ethical issues: Handling of animals.

Animal ethics; human volunteers-ICMR guidelines of ethical issues. Intellectual property rights. Conflict of interest, Issues on plagiarism. Intellectual property. Authorship issues: multiple authors, corresponding author. Safe handling and disposal of biological samples.

Writing reports- lab records, program reports, grant applications.

Unit-3

Modern Biochemical Techniques: Advanced techniques in Biochemical analysis- LC-MS, confocal microscopy, AFM, Real time PCR.

New models of Biochemical studies: Drosophila, Zebra fish, Trypanosoma, and *C. elegans*. Knock out, overexpression phenotype.

Integration of metabolic pathways of carbohydrate and lipid metabolism.

Cells of the immune system- PMNLS, macrophages, dendritic cells, T and B cells

Protein structure, function, Folding, solubility, limited proteolysis, modifications

Unit-4

Mechanism of drug action:Receptors (PPAR, LXR, RXR, AhR), downstream effectors, genes, agonists, antagonists, mechanisms, and toxicity, COX-1, COX-2, Drug metabolizing enzymes-Cyp.

Cell signaling:Signaling in animal and plant cells.

Regulation of eukaryotic gene expression.

References:

Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G (All Editions).

Molecular and Cellular Biology by Lodish and others (All Editions).
Molecular Biology of the Cell by Alberts and others (All Editions).

Note: For updates, students are advised to refer current literature (Research and review articles) in field journals.

Paper-II. Research and Publication Ethics – 2 Credits
32 Hours

Course Learning Outcomes

On completion of the course, the research scholar shall be able to:

1. Explain the principles of research integrity and ethical scholarly conduct.
2. Identify various forms of research and publication misconduct.
3. Apply authorship norms, citation ethics, and conflict-of-interest guidelines.
4. Use plagiarism detection tools and journal evaluation tools responsibly.
5. Interpret research metrics with due caution and responsibility.

Pedagogy

Lectures
Guided discussions
Hands-on sessions
Case analysis
Assignments/seminars

Assessment

Assessment shall include continuous evaluation and course-end examination as prescribed by the concerned Board of Studies in accordance with University norms.

Unit I: Philosophy, Ethics and Scientific Conduct

Introduction to Philosophy: definition, nature, scope, concepts and branches.
Ethics: definition and moral reasoning.
Ethics in science and research.
Intellectual honesty and research integrity.
Research misconducts: Fabrication, falsification and plagiarism (FFP).
Redundant publication (duplicate/overlapping publications, salami slicing).
Selective reporting and misrepresentation of data.

Unit II: Publication Ethics and Misconduct

Meaning and importance of publication ethics
Best practice guidelines (COPE, WAME, etc.)
Authorship and contributorship
Conflicts of interest
Publication misconducts: definition, causes, consequences and types.
Violation of publication ethics

Retraction policies and correction mechanisms in scholarly publishing.
Identification of publication misconduct.
Complaints and appeals.
Predatory journals and publishers.
Subject-specific ethical issues and case studies.

Unit III: Open Access and Scholarly Communication Tools

Open Access Publishing Models and Supporting Platforms: Gold, Green. Hybrid models; SHERPA/ROMEO, DOAJ, arXiv, SSRN, and self-archiving practices. Journal finder and journal suggestion tools.
Tools for Identifying and Verifying Predatory Journals: Cabells Predatory Reports, Beall's List, and whitelist/indexing platforms such as Directory of Open Access Journals (DOAJ), Scopus Source List, and Journal Citation. Reports (JCR).

Plagiarism detection software: tools, limitations, and responsible interpretation of similarity reports.
Good citation practices and responsible scholarly writing

Unit IV: Databases and Research Metrics

a. Databases

Indexing databases
Citation databases (Web of Science, Scopus, etc.)

b. Research Metrics

Journal Impact Factor and Journal Citation Reports
SNIP, SJR, IPP, CiteScore
Author metrics: h-index, g-index, i10-index
Introduction to altmetrics
Responsible use and limitations ofmetrics

References:

Amos, K.A. (2014). The ethics of scholarly publishing: Exploring differences in plagiarism
and duplicate publication across nations. Journal of the Medical Library Association, 102(2),
87-91. https://doi.org/10.3163/1536-5050.102.2.005
Basu, D., Chakraborty, S., & Sinha, A. (2021). Research and publication ethics: A textbook.
Concept Publishing Company Pvt. Ltd.
Bos, J., Hoeneveld, F., Steenbergen, N. V., Abma, R., Meijů, T. V., & Lepianka, D. (2020). Research ethics for students in the social sciences.
Springer.https://doi.org/10.1007/978-3-
030-48415-6
Chowdhary, N., & Hussain, S. (Eds.). (2021). Handbook of research and publication ethics.
Bharti Publications.

Committee on Publication Ethics. (2022, September 15). Principles of transparency and best
practice in scholarly publishing.
https://publicationethics.org/guidance/guideline/principlestransparency-and-best-practice-scholarly-publishing
Derricourt, R. (1996). An author's guide to scholarly publishing. Princeton University Press.
Elsevier. (2012). Ethics in research & publication.
https://www.publishingeampus.elsevier.com/websites/elsevier_publishingcampus/files/Guide
s/Brochure_Ethics 2_web.pdf
Horner, J., &Minifie, F. D. (2011). Research ethics III: Publication practices and authorship, conflicts of interest, and research misconduct. Journal of Speech, Language, and Hearing Research, 54(1), 346–362. https://doi.org/10.1044/1092-4388(2010/09-0263)
Iltis, A. S., & MacKay, D. (Eds.). (2024). The Oxford handbook of research ethics. Oxford University Press.
International Committee of Medical Journal Editors. (2022). Recommendations for the conduct, reporting, editing, and publication ofscholarly work in medical journals.
http://www.icmje.org/icmje-recommendations.pdf
Oliver, P. (2010). The student's guide to research ethics. McGraw-Hill Education.
Posner, R. A. (2007). The little book of plagiarism (1st ed.). Pantheon Books.
Ray, P. P. (2022). A guide to research and publication ethics: A textbook as per UGC guidelines for UG, PG, MPhil and PhD. New Delhi Publishers.
Roig, M. (2006). Avoiding plagiarism, self-plagiarism, and other questionable writing practices: A guide to ethical writing. Office of Research Integrity.
https://ori.hhs.gov/sites/default/files/plagiarism.pdf
Sheeba, P. S. (2024). Research and publication ethics: A comprehensive guide to ethical research practices. Notion Press.
Singh, U. P., Ahlawat, S., & Sharma, S. (2023). Research and publication ethics. Sultan Chand & Sons.
Tolich, M., &Iphofen, R. (Eds.). (2018). The SAGE handbook of qualitative research ethics. SAGE Publications.
Wager, E., & Kleinert, S. (2014). Responsible research publication: International standards
for authors. In A. Mayer & N. Steneck (Eds.), Promoting research integrity in a global environment (pp. 309–316). World Scientific.

Paper-III. Review of Literature (Broad Area) – 6 Credits

Objectives are:

- To work with research guide in scientific spirit.
- To know the current literature of the selected research problem.
- To learn about good laboratory practices and ethical issues.

Course outcome, the research student will:

- Understand how to work in a research group.
- Understand the use of scientific literature to support his research.
- Understand the importance of plagiarism and authorship issues.

Responsibility of the guide: The Guide shall ensure that the research student understands the following aspects. The Guide shall conduct tests/evaluation from time to time and have the IA marks ready.

Current status of the lab:

1) Ongoing projects/ past projects/ publications resulting from the Guide's Research group. Any novel technique developed. The review of the literature pertinent to candidates work- relevant publications. Identification of Research problem, identifying gaps in the knowledge, formulating objectives and work plan.
2) **Review of the allied fields**- Literature of the allied area to candidate's field, outstanding publications.
3) **Authorship issues-** the primary author, corresponding author, contributing author, etc., Guide's responsibility to assign the appropriate authorships.
4) **Plagiarism-** adopting a figure v/s cut and paste and its implications in plagiarism.
5) **Sharing reagents/ chemicals/ methods in lab**- team work is essential.

How to publish/ present in seminars/ symposia/ meeting proceedings.

Special Note: To remain competitive,research fellows are advised to read and assimilate the current knowledge published in research journals.

M.Sc. Biochemistry (P.G.)
List of Examiners 2026

Names	Address
Dr. K. Kemparaju	Department of Studies in Biochemistry, Manasagangotri, University of Mysore, Mysore - 570 006
Dr. Noor Mohammed Jameel	
Dr. Pavithra	
Mrs. Uzma A.S.	
Mrs. Pavithra N.	
Mr. Gangadharswamy J.	
Dr Revanasiddappa	Department of Studies in Chemistry, Manasagangotri, University of Mysore, Mysore - 570 006
Dr. Mantelingu K	
Dr. Sadashiva	
Dr. Mohan	
Dr. Priya	
Dr.Aparna H.S	Department of Studies in Biotechnology, Manasagangotri, University of Mysore, Mysore - 570 006
Dr.Ramachandral Kini	
Dr.Umesha S.	
Dr.Geetha N.	
Dr. Janardhana G R.	Department of Studies in Botany, Manasagangotri, University of Mysore, Mysore - 570006
Dr. Amruthesh	
Dr. Rajkumar Garampalli	
Dr.Bhagya M	Department of Studies in Zoology, Manasagangotri, University of Mysore, Mysore - 570006
Dr.Malini S. S	
Dr Basavarajappa S	
Dr. Krishna M.S	
Dr.Shakuntala V.	
Dr Shubha Gopal	Department of Studies in Microbiology, Manasagangotri University of Mysore, Mysore - 570006
Dr. Satish S	
Dr. Srinivasa M.Y.	
Dr. V.R. Devaraj	Department of Biochemistry, Bangalore University, Bangalore
Dr. C S Karigar	
Dr. Manjunath	
Dr. Srinivas Bharath	Department of Neurochemistry, NIMHANS. Bangalore
Dr. G Chethan	Department of Human Genetics, NIMHANS. Bangalore
Dr. K. Devaraju	Department of Biochemistry, Karnataka University, Dharwad- 580003
Dr. Kamanavalli	
Dr. Vishwanath Chachdi	

Dr.Paramjyothi	Department of Biochemistry, Gulbarga University
Dr. V. Kumar	Department of Biochemistry, Davanagere University Tolahunse Campus. Davangere
Dr. Neelgund S.E.	Department of Biochemistry, Kuvempu University Shankaraghatta, Shimoga
Dr. Sathish G J.	
Dr. K.S Girish	Department of Biochemistry, Tumkur University, Tumkur
Dr. Manohar Sindhe	
Dr. S. Devaraja	
Dr. S. Nagaraju	
Dr. Chandrashekar Joshi	Department of Biochemistry, P.G. Center of Mangalore University, ChikkaAluvar, Torenoor Post, Kushala Nagar'
Dr. K.K. Dharmappa	
Dr. O.V.S. Reddy	Department of Biochemistry, S.V. University, Tirupati
Dr. Balaji	
Dr. S.D.S.Murthy	
Dr. P.V Balaji	Department of Biotechnology, IIT, Powai, Mumbai'
Dr. Kiran K	
Smt. Kavitha K.R	Department of Biochemistry, Government Science College Hassan
Dr. Kumar M.S.	Maharani's science College for Women, P.G. Department of Biochemistry J.L.B. Road, Mysore
Smt. Prernalatha S,J.	
Dr. Jyothsna Karanth	
Dr. Jyothi Bala Chouhan	Pooja Bhagwat Mahajana College, K.R.S. Road Mysore
Dr. Girish Chandra	
Dr. Mahadesh Prasad	
Dr. Ravi Manjithaiya	JNCASR, Jakkur, Bangalore
Dr. Madhu D	Department of Biochemistry and Molecular Biology Pondicherry University, kalapet, Pondicherry.
Dr. Thejashwini Venkatesh	Department of Biochemistry and Molecular Biology, Kerala Central University Kasargud
Dr. Chethan Kumar M	Post Graduate Department of Biochemistry, JSS College of Arts, Commerce and Science, Ooty Road, Mysuru - 570 025
Dr. B.V. Latha	
Dr. Syeda Hajira Banu	
Dr. Sunitha Prashanth	
Dr. J.R. Kumar	Division of Biochemistry, School of Life Sciences, JSS AHER, Mysuru.
Dr. J.M. Siddesha	
Dr. Raghu Ram Achar	
Dr. Subbarao	

Chairman

Course: Ph.D. Degree in Biochemistry

Course work Syllabus

March 2026

Total Credits = 12

Programme objectives

The main objective of this Ph.D. Degree programme is to provide strong foundation to

- To understand the basic problems in current research scenario and find meaningful solutions.
- To develop as an independent researcher both in academic institutions and in R & D programmes of industries.
- To take up research problems at higher level to work as a postdoctoral fellow worldwide.
- To take up teaching profession in academic institutions

Programme Outcomes

On successful completion of this programme each Ph.D. scholar will:

- Have thorough knowledge of current literature in the specified area.
- Know how to design experiments to address the chosen research problem.
- Have confidence to write publications in the peer reviewed Journals.
- Have the knowledge to take up research and teaching independently.

Course No.	Course Title	Internal Assessment (C1 + C2)	C3 Assessment	Max. Marks	Min. Marks	Credits	Duration of Exam
I	Research Methodology	15+15=30	70	100	50	4	3 hrs
II	Research and Publication Ethics	10+10=20	30	50	25	2	2 hrs
III	Review of Literature (Broad Area)	15+15=30	70 (Report+Viva)	100	50	6	

Paper-I. Research Methodology- 4 Credits

Objectives are:

- To learn types of research.
- To learn about various research models with the use of advanced techniques
- To learn about good laboratory practices and ethical issues.
- To learnthe applications of suitable statistical analysis.

Course outcome, the research student will:

- Understand the use of appropriate biological samples or animal model to address the selected research problem

- Understand the applications of advanced techniques.
- Understand the signaling pathways at cellular levels.

Unit-1

Types of Research- Academic, Industrial, clinical, Basic research, applied research. Research objectives. Review of literature-identifying gaps; formulating hypothesis, ecting research topics.

Collection of Research Material: Information, types and sources. Pubmed as a resource. Collection, classification and retrieval of information.

Research Design: Types of studies-cohort, double blind, placebo control, cross over. Overview of Framingham study.

Statistical methods: Error and its significance, choosing sample size, collection of data-questionnaire; methods of scaling, collection analysis and presentation of data. Parametric and non-parametric tests and when to use them.

Unit-2

Ethical issues: Handling of animals.

Animal ethics; human volunteers-ICMR guidelines of ethical issues. Intellectual property rights. Conflict of interest, Issues on plagiarism. Intellectual property. Authorship issues-multiple authors, corresponding author. Safe handling and disposal of biological samples. Writing reports- lab records, program reports, grant applications.

Unit-3

Modern Biochemical Techniques: Advanced techniques in Biochemical analysis- LC-MS, confocal microscopy, AFM, Real time PCR.

New models of Biochemical studies: Drosophila, Zebra fish, Trypanosoma and *C. elegans*. Knock out, overexpression phenotype.

Integration of metabolic pathways of carbohydrate and lipid metabolism.

Cells of immune system- PMNLS, macrophages, dendritic cells, T and B cells

Protein structure function, Folding, solubility, limited proteolysis, modifications

Unit-4

Mechanism of drug action:_Receptors (PPAR, LXR, RXR, AhR) downstream effectors, genes, agonists, antagonists, mechanisms and toxicity, COX-1, COX-2, Drug metabolizing enzymes-Cyp.

Cell signaling: Signaling in animal and plant cells.

Regulation of eukaryotic gene expression.

References:

Lehninger Principles of Biochemistry by Nelson and Cox (All Editions).
Biochemistry by Lubert Stryer (All Editions).
Textbook of Biochemistry by Devlin (All Editions).
Biochemistry by Voet D, Voet JG (All Editions).
Biochemistry by Zuby G (All Editions).
Molecular and Cellular Biology by Lodish and others (All Editions).
Molecular Biology of the Cell by Alberts and others (All Editions).

Note: For updates, students are advised to refer current literature (Research and review articles) in field journals.

Paper-II. Research and Publication Ethics – 2 Credits

32 Hours

Course Learning Outcomes

On completion of the course, the research scholar shall be able to:

1. Explain the principles of research integrity and ethical scholarly conduct.
2. Identify various forms of research and publication misconduct.
3. Apply authorship norms, citation ethics, and conflict-of-interest guidelines.
4. Use plagiarism detection tools and journal evaluation tools responsibly.
5. Interpret research metrics with due caution and responsibility.

Pedagogy

Lectures
Guided discussions
Hands-on sessions
Case analysis
Assignments/seminars

Assessment

Assessment shall include continuous evaluation and course-end examination as prescribed by the concerned Board of Studies in accordance with University norms.

Unit I: Philosophy, Ethics and Scientific Conduct

Introduction to Philosophy: definition, nature, scope, concepts and branches.
Ethics: definition and moral reasoning.
Ethics in science and research.
Intellectual honesty and research integrity.
Research misconducts: Fabrication, falsification and plagiarism (FFP).
Redundant publication (duplicate/overlapping publications, salami slicing).
Selective reporting and misrepresentation of data.

Unit II: Publication Ethics and Misconduct

Meaning and importance of publication ethics
Best practice guidelines (COPE, WAME, etc.)
Authorship and contributorship
Conflicts of interest
Publication misconducts: definition, causes, consequences and types.
Violation of publication ethics
Retraction policies and correction mechanisms in scholarly publishing.
Identification of publication misconduct.
Complaints and appeals.
Predatory journals and publishers.

Subject-specific ethical issues and case studies.

Unit III: Open Access and Scholarly Communication Tools

Open Access Publishing Models and Supporting Platforms: Gold, Green. Hybrid models; SHERPA/ROMEO, DOAJ, arXiv, SSRN, and self-archiving practices. Journal finder and journal suggestion tools.
Tools for Identifying and Verifying Predatory Journals: Cabells Predatory Reports, Beall's List, and whitelist/indexing platforms such as Directory of Open Access Journals (DOAJ), Scopus Source List, and Journal Citation. Reports (JCR).

Plagiarism detection software: tools, limitations, and responsible interpretation of similarity reports.
Good citation practices and responsible scholarly writing

Unit IV: Databases and Research Metrics

a. Databases

Indexing databases
Citation databases (Web of Science, Scopus, etc.)

b. Research Metrics

Journal Impact Factor and Journal Citation Reports
SNIP, SJR, IPP, CiteScore
Author metrics: h-index, g-index, i10-index
Introduction to altmetrics
Responsible use and limitations ofmetrics

References:

Amos, K.A. (2014). The ethics of scholarly publishing: Exploring differences in plagiarism
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Bos, J., Hoeneveld, F., Steenbergen, N. V., Abma, R., Meijů, T. V., & Lepianka, D. (2020). Research ethics for students in the social sciences.
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Chowdhary, N., & Hussain, S. (Eds.). (2021). Handbook of research and publication ethics.
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practice in scholarly publishing.
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Roig, M. (2006). Avoiding plagiarism, self-plagiarism, and other questionable writing practices: A guide to ethical writing. Office of Research Integrity. https://ori.hhs.gov/sites/default/files/plagiarism.pdf
Sheeba, P. S. (2024). Research and publication ethics: A comprehensive guide to ethical research practices. Notion Press.
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Tolich, M., &Iphofen, R. (Eds.). (2018). The SAGE handbook of qualitative research ethics. SAGE Publications.
Wager, E., & Kleinert, S. (2014). Responsible research publication: International standards
for authors. In A. Mayer & N. Steneck (Eds.), Promoting research integrity in a global environment (pp. 309–316). World Scientific.

Paper-III. Review of Literature (Broad Area) – 6 Credits

Objectives are:

- To work with research guide in scientific spirit.
- To know the current literature of the selected research problem.
- To learn about good laboratory practices and ethical issues.

Course outcome, the research student will:

- Understand how to work in a research group.
- Understand the use of scientific literature to support his research.
- Understand the importance of plagiarism and authorship issues.

<u>Responsibility of the guide:</u> The Guide shall ensure that the research student understands the following aspects. The Guide shall conduct tests/evaluation from time to time and have the IA marks ready.

Current status of the lab:

1) Ongoing projects/ past projects/ publications resulting from the Guide's Research group. Any novel technique developed. The review of the literature pertinent to candidates work- relevant publications. Identification of Research problem, identifying gaps in the knowledge, formulating objectives and work plan.
2) **Review of the allied fields**- Literature of the allied area to candidate's field, outstanding publications.
3) **Authorship issues-** the primary author, corresponding author, contributing author, etc., Guide's responsibility to assign the appropriate authorships.
4) **Plagiarism-** adopting a figure v/s cut and paste and its implications in plagiarism.
5) **Sharing reagents/ chemicals/ methods in lab**- team work is essential.

How to publish/ present in seminars/ symposia/ meeting proceedings.

Special Note: Research fellows are advised to read and assimilate the current knowledge published in research journals.